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## Table of Contents.

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| ORIGINAL ARTICLES—  | Page. | BRITISH MEDICAL ASSOCIATION NEWS—                | Page. |
|---|-------|--|-------|
| The Thyroid Gland and Hæmopoiesis, by T. E. Wilson, M.D., M.S., B.Sc., M.R.A.C.P., F.R.A.C.S. | 261   | Scientific .. .. .                               | 280   |
| Industrial Medicine, by W. T. Nelson, M.D., M.R.C.P., F.R.A.C.P.                              | 269   | <b>OBITUARY—</b>                                 |       |
| <b>REPORTS OF CASES—</b>  |       | John Ramsay .. .. .                              | 282   |
| Epicondylitis: Traumatic Radio-Humeral Synovitis, by J. C. Bell Allen, F.R.C.S.               | 273   | <b>POST-GRADUATE WORK—</b>                       |       |
| <b>REVIEWS—</b>   |       | Week-End Course at Armidale .. .. .              | 283   |
| The Development of the Child .. .. .  | 274   | <b>CORRESPONDENCE—</b>                           |       |
| <b>LEADING ARTICLES—</b>  |       | Otitis Externa Diffusa: A Personal Experience .. | 283   |
| Industrial Medicine and the Future .. .. .  | 275   | <b>NAVAL, MILITARY AND AIR FORCE—</b>            |       |
| <b>CURRENT COMMENT—</b>   |       | Casualties .. .. .                               | 284   |
| Detachment of the Retina and Trauma .. .. .   | 276   | <b>AUSTRALIAN MEDICAL BOARD PROCEEDINGS—</b>     |       |
| From the Patient's Point of View .. .. .  | 277   | New South Wales .. .. .                          | 284   |
| <b>ABSTRACTS FROM MEDICAL LITERATURE—</b>   |       | <b>BOOKS RECEIVED .. .. .</b>                    | 284   |
| Surgery .. .. .   | 278   | <b>DIARY FOR THE MONTH .. .. .</b>               | 284   |
|   |       | <b>MEDICAL APPOINTMENTS: IMPORTANT NOTICE ..</b> | 284   |
|   |       | <b>EDITORIAL NOTICES .. .. .</b>                 | 284   |

### THE THYROID GLAND AND HÆMOPOIESIS.<sup>1</sup>

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THE anæmias of myxœdema and cretinism have excited an interest in the peripheral blood of subjects suffering from these diseases, but rarely has this interest been extended to the rest of the hæmopoietic system. Even thyrotoxicosis, a disease exhaustively studied by the physician and the biochemist, has been somewhat overlooked by the hæmatologist.

#### Historical Review.

Dierterle<sup>(1)</sup> and Stoccarda<sup>(2)</sup> originally reported small series of cretins examined at autopsy, in whom much of the red marrow was replaced by inactive fatty marrow. More recently Diwany<sup>(3)</sup> described the bone marrow obtained by sternal puncture from two cretins as hypoplastic, whereas the differential counts and the morphological examination of the marrow cells gave results within normal limits.

Working with young rabbits, Esser<sup>(4)</sup> and later Tatum<sup>(5)</sup> showed that thyroidectomy resulted in the development of inactive fatty marrow. This was confirmed by Kunde, Green and Burns,<sup>(6)</sup> who also reported that in the rabbit hypothyroidism was characterized by an increased diameter of the erythrocytes and a colour index greater than one. In their animals experimental hyperthyroidism caused an initial polycythæmia with a corresponding increase in hæmoglobin value, but later a hypochromic anæmia developed.

<sup>1</sup>This work was performed during the tenure of an Alcock and Alwyn Stewart Scholarship of the University of Melbourne and during the tenure of a Fellowship in Surgery at Prince Henry Hospital, Sydney, 1940 and 1941.

Bomford<sup>(7)</sup> has reported that the sternal marrow aspirated from myxœdematous patients was "markedly hypoplastic" and that desiccated thyroid or thyroxin caused an increase in the number of nucleated cells to normal; similar results were obtained by Jones.<sup>(8)</sup> Although hypothyroidism affects the response to liver therapy in pernicious anæmia, Limarzi<sup>(9)</sup> was unable to find any disturbance of the characteristic bone marrow pattern in untreated pernicious anæmia complicated by myxœdema.

There is surprisingly little agreement as to the changes present in the peripheral blood in thyrotoxicosis. For example, Jackson<sup>(10)</sup> found no significant variation from normal in a series of 600 cases. Against this, Kocher<sup>(11)</sup> originally described leucopenia with lymphocytosis and monocytosis, and since then McCullagh and Dunlap<sup>(12)</sup> have described relative lymphocytosis, Hertz and Lerman<sup>(13)</sup> leucopenia with absolute monocytosis and a shift to the left in the granular series, Gottlieb<sup>(14)</sup> leucopenia with a shift to the right in the granular series, Zondek and Kaatz<sup>(15)</sup> an increase in the number of platelets, and Woodruff<sup>(16)</sup> a decrease in the number of platelets.

Hyperplasia of the bone marrow in thyrotoxicosis was demonstrated by Jones,<sup>(8)(17)</sup> who considered that it was limited to the myeloid series and the megakaryocytes. Jones also reported that in his cases there was a consistent decrease in the cellularity of the marrow after thyroidectomy. There was no leucocytosis in the peripheral blood of these thyrotoxic subjects, and a similar hyperplasia of the marrow in the absence of leucocytosis in the peripheral blood of young rabbits fed on thyroid substance has been described by Lim, Sarkar and Brown.<sup>(18)</sup>

On the experimental side, Adams and Skevket<sup>(19)</sup> have reported anæmia and reticulocytosis in rats after thyroid feeding.

Because of these rather conflicting reports, a study was made of the blood and bone marrow of a series of patients suffering from thyrotoxicosis and of one patient suffering from myxœdema. The blood, bone marrow and other changes produced in the rat by thyroidectomy and by the injection of thyroxin were also investigated.

## Clinical Methods.

Thirty-one patients suffering from severe thyrotoxicosis and one patient suffering from myxœdema were chosen for study. No differentiation was made for the purposes of this paper between hyperplasia of the thyroid and toxic adenoma of the thyroid. As far as could be ascertained, these patients were free from any other disease. The numbers allotted to these cases are the same as those used previously.<sup>(26) (28)</sup> For estimating the colour index, an amount of 14.0 grammes of hæmoglobin per 100 millilitres of blood was taken as 100%. The blood films were stained by Leishman's stain. For the estimation of the number of platelets Wright and Kinnicutt's method<sup>(28)</sup> was used. The bleeding time was estimated by Duke's method,<sup>(29)</sup> and the coagulation time by Lee and White's venous method.<sup>(30)</sup> The prothrombin time was estimated by Quick's method<sup>(31)</sup> and expressed as a percentage of normal. The bone marrow was obtained by sternal puncture and aspiration; approximately 0.2 millilitre was aspirated. No anticoagulant was used. The aspirated marrow was deposited on clean glass slides; portion of this fluid was diluted in a white cell pipette and the cells counted in the usual manner. Smears from the aspirated marrow were quickly made, dried in air and then stained with Leishman's stain. For the differential counts at least 1,000 cells were counted in the marrow smears and at least 200 cells in the smears of the peripheral blood. The nomenclature used for the cells of the blood and bone marrow is the same as that employed previously.<sup>(32)</sup> In all cases the blood and marrow specimens were collected within a day or two of the patient's admission to hospital. In ten cases the blood and marrow examinations were repeated after operation just prior to the patient's discharge from hospital; subtotal thyroidectomy was performed in nine of these cases and total thyroidectomy in the other one. After operation the excised thyroid gland was examined microscopically. Of the six patients who died, an autopsy was performed on four (Cases 6, 9, 21 and 28).

As a control series Table I is included. This table contains the blood and marrow findings in sixteen otherwise healthy young adults who had been admitted to hospital for the treatment of herniæ, hydroceles or varicoceles.

These patients were all males aged between twenty and thirty years, and are therefore not strictly comparable with this series of thyrotoxic patients, most of whom were females, and whose average age was forty-one years. However, since there is no reason to believe that either sex or age *per se* causes a significant variation in the peripheral blood or sternal marrow findings of adults, this control series is provisionally accepted as such. It will be noticed that, unfortunately, hæmatocrit estimations were not included in the control series. The normal standards for these figures and for the indices calculated from them have been taken from the paper of Price-Jones *et alii*.<sup>(37)</sup>

## Clinical Results.

The results of the blood and bone marrow counts in the sixteen cases forming the control series are contained in Table I; for comparison, the figures of other authors are summarized in Table II. Table III contains the results of the blood and marrow counts in the 31 cases of thyrotoxicosis, estimated before treatment was commenced. At the foot of this table are shown the means and the standard deviations of these figures. From Tables I and III it can be calculated that the hæmoglobin and erythrocyte levels of the peripheral blood of the thyrotoxic patients were significantly decreased, the percentage of monocytes of the marrow was significantly decreased, and the total marrow cell count was significantly increased. This decrease in the monocyte percentage was mainly a relative one brought about by the hyperplasia of the other cells of the marrow. This may be taken as evidence that few monocytes are normally formed in the marrow, and that most of the monocytes present in the marrow are derived from the peripheral blood. The other figures for the blood of the thyrotoxic patients were not significantly different from those of the control series. The bleeding, coagulation and prothrombin times, the hæmatocrit values and the indices derived from them fell within normal limits.<sup>(32) (36) (37) (38)</sup>

The standard deviation is given for each series of figures in the tables of this paper, but because of the small samples discussed the common standard deviations were estimated and Fisher's table of *t*<sup>(39)</sup> was employed when the

TABLE I.  
Results of Blood and Bone Marrow Counts on Sixteen Normal Adult Males.<sup>1</sup>

| Blood.                                |  |                                 |   |                                     |                               |                             |                                     |                                   |  | Bone Marrow.                        |                                      |   |                              |                                 |                               |                                     |                                   |   |                                |                               |                               |                                      |                                       |                                 |                                   |                                 |                                  |   |
|---------------------------------------|--|---------------------------------|---|-------------------------------------|-------------------------------|-----------------------------|-------------------------------------|-----------------------------------|--|-------------------------------------|--------------------------------------|---|------------------------------|---------------------------------|-------------------------------|-------------------------------------|-----------------------------------|---|--------------------------------|-------------------------------|-------------------------------|--------------------------------------|---------------------------------------|---------------------------------|-----------------------------------|---------------------------------|----------------------------------|---|
| Hæmoglobin.<br>(Gramines per Centum.) | Erythrocytes (Millions<br>per Cubic Millimetre.) | Reticulocytes,<br>(Percentage.) | Leucocytes (Thousands<br>per Cubic Millimetre.) | Neutrophile Cells,<br>(Percentage.) | Lymphocytes,<br>(Percentage.) | Monocytes,<br>(Percentage.) | Eosinophile Cells,<br>(Percentage.) | Basophile Cells,<br>(Percentage.) | Platelets (Thousands<br>per Cubic Millimetre.) | Neutrophile Cells,<br>(Percentage.) | Old Metamyelocytes,<br>(Percentage.) | Young Metamyelo-<br>cytes (Percentage.) | Myelocytes,<br>(Percentage.) | Promyelocytes,<br>(Percentage.) | Myeloblasts,<br>(Percentage.) | Eosinophile Cells,<br>(Percentage.) | Basophile Cells,<br>(Percentage.) | Monocytes<br>(Percentage.) <sup>2</sup> | Plasma Cells,<br>(Percentage.) | Lymphocytes,<br>(Percentage.) | Normoblasts,<br>(Percentage.) | Late Erythroblasts,<br>(Percentage.) | Early Erythroblasts,<br>(Percentage.) | Promonoblasts,<br>(Percentage.) | Mitotic Figures,<br>(Percentage.) | Ratio of Red to<br>White Cells. | Megakaryocytes,<br>(Percentage.) | Marrow Cell Counts in<br>Thousands per Cubic<br>Millimetre. |
| 14.2                                  | 5.3  | 0.5                             | 7.5   | 55.5                                | 35.5                          | 4.0                         | 4.5                                 | 0.5                               | 194  | 17.5                                | 14.3                                 | 9.4                                     | 8.6                          | 2.1                             | 0.1                           | 3.4                                 | 0.2                               | 1.4                                     | 2.0                            | 9.7                           | 29.6                          | 1.2                                  | 0.1                                   | —                               | 0.4                               | 1:1.2                           | —                                | 46.0  |
| 14.0                                  | 4.8  | 1.0                             | 4.9   | 76.0                                | 19.0                          | 3.5                         | 2.2                                 | 0.5                               | 245  | 23.1                                | 15.7                                 | 8.4                                     | 5.3                          | 0.12                            | —                             | 3.2                                 | 0.4                               | 3.6                                     | 1.1                            | 12.8                          | 30.8                          | 0.4                                  | —                                     | —                               | 0.1                               | 1:1.2                           | —                                | 137.2   |
| 13.8                                  | 4.9  | 0.6                             | 6.5   | 66.0                                | 26.5                          | 3.6                         | 4.0                                 | —                                 | 301  | 10.9                                | 18.3                                 | 4.5                                     | 4.7                          | 0.2                             | —                             | 4.5                                 | 0.3                               | 3.2                                     | 1.1                            | 12.8                          | 30.8                          | 0.7                                  | 0.3                                   | —                               | 0.2                               | 1:1.5                           | —                                | 119.9   |
| 14.4                                  | 5.5  | 0.9                             | 7.5   | 50.0                                | 41.0                          | 5.5                         | 3.5                                 | —                                 | 238  | 19.4                                | 23.7                                 | 6.2                                     | 4.9                          | 1.0                             | 0.2                           | 3.2                                 | 0.1                               | 2.5                                     | 0.9                            | 8.0                           | 29.6                          | 0.2                                  | —                                     | —                               | 0.1                               | 1:1.2                           | 0.2                              | 30.3  |
| 13.5                                  | 5.0  | 1.2                             | 5.7   | 43.5                                | 47.5                          | 3.0                         | 6.5                                 | 0.5                               | 220  | 13.7                                | 29.6                                 | 9.8                                     | 9.4                          | 0.4                             | —                             | 4.0                                 | 0.4                               | 4.5                                     | 2.1                            | 3.4                           | 21.2                          | 1.4                                  | —                                     | —                               | —                                 | 1:1.3                           | 0.4                              | 155.8   |
| 13.5                                  | 4.7  | 0.4                             | 9.6   | 52.0                                | 40.0                          | 6.0                         | 3.0                                 | —                                 | 253  | 19.2                                | 18.5                                 | 12.4                                    | 6.1                          | 1.1                             | —                             | 5.7                                 | 0.4                               | 7.9                                     | 0.5                            | 7.0                           | 29.6                          | 0.8                                  | 0.3                                   | —                               | —                                 | 1:1.2                           | —                                | 84.8  |
| 14.8                                  | 6.2  | 0.6                             | 5.0   | 54.5                                | 38.0                          | 3.5                         | 3.0                                 | —                                 | 317  | 14.5                                | 21.0                                 | 12.4                                    | 6.1                          | 1.1                             | —                             | 4.3                                 | —                                 | 3.4                                     | 0.8                            | 6.3                           | 41.2                          | 0.9                                  | 0.4                                   | —                               | 0.2                               | 1:1.3                           | —                                | 226.2   |
| 14.4                                  | 5.3  | 1.2                             | 5.5   | 68.5                                | 24.5                          | 4.5                         | 5.5                                 | —                                 | 208  | 23.6                                | 25.6                                 | 4.2                                     | 5.8                          | 0.4                             | —                             | 4.3                                 | —                                 | 3.8                                     | 1.2                            | 10.8                          | 24.5                          | 0.6                                  | 0.4                                   | —                               | 0.1                               | 1:1.2                           | —                                | 135.4   |
| 14.0                                  | 4.9  | 0.5                             | 8.7   | 55.5                                | 37.0                          | 5.0                         | 1.0                                 | —                                 | 319  | 18.6                                | 14.4                                 | 1.2                                     | 3.2                          | —                               | —                             | 12.1                                | 0.1                               | 0.9                                     | 1.3                            | 3.2                           | 45.3                          | 0.6                                  | 0.2                                   | —                               | 0.1                               | 1:1.0                           | 0.1                              | 136.2   |
| 14.1                                  | 5.2  | 0.4                             | 9.4   | 49.0                                | 47.5                          | 2.5                         | 1.0                                 | —                                 | 106  | 9.3                                 | 18.7                                 | 3.0                                     | 3.4                          | 0.4                             | 0.3                           | 12.1                                | —                                 | 1.2                                     | 0.7                            | 6.5                           | 24.4                          | 0.1                                  | —                                     | —                               | —                                 | 1:0.83                          | —                                | 19.6  |
| 13.9                                  | 5.1  | 0.8                             | 7.7   | 41.0                                | 50.5                          | 3.0                         | 4.5                                 | 1.0                               | 227  | 21.0                                | 19.3                                 | 7.7                                     | 8.7                          | 0.8                             | 0.2                           | 3.6                                 | —                                 | 4.5                                     | 0.5                            | 5.3                           | 32.2                          | 0.1                                  | —                                     | —                               | —                                 | 1:1.2                           | 0.5                              | 228.0   |
| 13.6                                  | 5.4  | 1.2                             | 6.3   | 61.5                                | 32.5                          | 4.0                         | 1.5                                 | 0.5                               | 246  | 17.2                                | 24.1                                 | 3.6                                     | 6.0                          | 0.9                             | 0.2                           | 5.7                                 | 0.1                               | 3.8                                     | 1.6                            | 4.0                           | 26.4                          | 1.5                                  | 0.5                                   | —                               | 0.4                               | 1:2.5                           | 0.7                              | 143.7   |
| 13.9                                  | 5.0  | 1.6                             | 7.9   | 54.0                                | 40.5                          | 4.0                         | 1.5                                 | —                                 | 258  | 22.5                                | 28.5                                 | 8.0                                     | 5.5                          | 1.2                             | 0.1                           | 3.3                                 | —                                 | 3.9                                     | 0.3                            | 3.7                           | 17.0                          | 0.6                                  | 0.2                                   | —                               | 0.3                               | 1:1.4                           | 0.6                              | 324.8   |
| 13.7                                  | 4.8  | 0.8                             | 6.0   | 63.5                                | 27.0                          | 6.5                         | 3.0                                 | —                                 | 274  | 15.9                                | 29.2                                 | 12.5                                    | 9.9                          | 0.7                             | —                             | 0.8                                 | —                                 | 1.2                                     | 0.2                            | 3.0                           | 32.7                          | 0.3                                  | —                                     | —                               | —                                 | 1:2.0                           | 0.7                              | 154.5   |
| 14.4                                  | 5.0  | 0.7                             | 4.9   | 69.0                                | 25.0                          | 4.0                         | 1.5                                 | 0.5                               | 276  | 14.5                                | 19.6                                 | 12.0                                    | 8.9                          | 0.2                             | 0.1                           | 4.0                                 | 0.1                               | 2.2                                     | 1.4                            | 2.8                           | 32.5                          | 0.4                                  | 0.6                                   | —                               | 0.2                               | 1:2.0                           | —                                | 59.2  |
| 14.4                                  | 5.2  | 0.4                             | 9.6   | 65.5                                | 30.0                          | 2.5                         | 2.0                                 | —                                 | 217  | 18.0                                | 30.7                                 | 8.7                                     | 6.4                          | 0.1                             | —                             | 2.2                                 | 0.2                               | 2.2                                     | 1.0                            | 6.4                           | 23.2                          | 0.4                                  | 0.2                                   | —                               | 0.3                               | 1:3.2                           | —                                | 43.7  |
| Mean                                  | 5.2  | 0.9                             | 7.2   | 57.8                                | 35.1                          | 4.0                         | 2.8                                 | 0.2                               | 232.4  | 17.80                               | 22.18                                | 6.85                                    | 5.74                         | 0.62                            | 0.10                          | 3.02                                | 0.10                              | 3.09                                    | 1.06                           | 6.33                          | 32.15                         | 0.63                                 | 0.19                                  | 0.02                            | 0.14                              | 1:2.30                          | 0.08                             | 40.85   |
| S.D. <sup>4</sup>                     | 0.4  | 0.4                             | 1.7   | 9.8                                 | 9.3                           | 1.2                         | 1.3                                 | 0.3                               | 26.1   | 4.71                                | 5.70                                 | 3.61                                    | 2.41                         | 0.56                            | 0.13                          | 1.53                                | 0.12                              | 1.72                                    | 0.55                           | 2.90                          | 10.17                         | 0.45                                 | 0.19                                  | 0.04                            | 0.15                              | 1:1.02                          | 0.09                             | 16.79   |

<sup>1</sup> Bone marrow was obtained by sternal puncture and aspiration.

<sup>2</sup> These patients had been admitted to hospital for remedial treatment of herniæ, hydroceles or varicoceles, and were otherwise apparently healthy. Their ages varied from 20 to 30 years.

<sup>3</sup> Including histiocytes.

<sup>4</sup> Standard deviation.

TABLE II.

Summary of Results of Bone Marrow Counts on Sternal Puncture Material from Normal Human Adults.

| Author.  | Number and Sex of Cases. | Bone Marrow.                        |                                      |  |                              |                                 |                               |                                     |                                   |                             |                                |                               |                               |                                      |                                       |                                  |                                   |                              |                                  |  |
|--|--------------------------|-------------------------------------|--------------------------------------|--|------------------------------|---------------------------------|-------------------------------|-------------------------------------|-----------------------------------|-----------------------------|--------------------------------|-------------------------------|-------------------------------|--------------------------------------|---------------------------------------|----------------------------------|-----------------------------------|------------------------------|----------------------------------|--|
|  |                          | Neutrophile Cells.<br>(Percentage.) | Old Metamyelocytes.<br>(Percentage.) | Young Metamyelocytes.<br>(Percentage.) | Myelocytes.<br>(Percentage.) | Premyelocytes.<br>(Percentage.) | Myeloblasts.<br>(Percentage.) | Eosinophile Cells.<br>(Percentage.) | Basophile Cells.<br>(Percentage.) | Monocytes.<br>(Percentage.) | Plasma Cells.<br>(Percentage.) | Lymphocytes.<br>(Percentage.) | Normoblasts.<br>(Percentage.) | Late Erythroblasts.<br>(Percentage.) | Early Erythroblasts.<br>(Percentage.) | Pronormoblasts.<br>(Percentage.) | Mitotic Figures.<br>(Percentage.) | Ratio of Red to White Cells. | Megakaryocytes.<br>(Percentage.) | Marrow Cell Count in Thousands per Cubic Millimetre. |
| Wilson <sup>2</sup> —<br>Mean ..<br>S.D. <sup>4</sup> .. | 16 M. <sup>3</sup>       | 17.80<br>4.71                       | 22.18<br>5.70                        | 6.85<br>3.61                           | 5.74<br>2.41                 | 0.62<br>0.56                    | 0.10<br>0.13                  | 3.02<br>1.53                        | 0.10<br>0.12                      | 3.09<br>1.72                | 1.06<br>0.55                   | 6.33<br>2.90                  | 32.15<br>10.17                | 0.63<br>0.45                         | 0.19<br>0.19                          | 0.20<br>0.04                     | 0.14<br>0.15                      | 1:2.30<br>1:1.02             | 0.08<br>0.09                     | 40.85<br>16.79                                       |
| Segerdahl <sup>(11)</sup> ..                             | 110 M., F. <sup>5</sup>  | 23.3                                | 8.3                                  | 14.8                                   | 14.2                         | 1.5                             | 1.3                           | 3.0                                 | 0.2                               | 2.3                         | 6.5                            | 19.5                          | 12.3                          | —                                    | —                                     | —                                | —                                 | 1:0.71                       | —                                | —  |
| Nordenson <sup>(12)</sup> ..                             | 38 M., F.                | (a) 14.2<br>(b) 35.0                | 12.2<br>10.7                         | 12.5<br>42.5                           | 4.2<br>18.0                  | 1.2<br>8.2                      | 0.3<br>5.5                    | 0.2<br>13.7                         | —                                 | —                           | —                              | 7.5<br>35.0                   | 26.0<br>84.0                  | —                                    | —                                     | —                                | —                                 | —                            | 1.0                              | —  |
| Young and Os-<br>good <sup>(13)</sup> ..                 | 28 M., F.                | (a) 7.4<br>(b) 25.2                 | 15.8<br>33.0                         | 1.8<br>9.8                             | —<br>2.6                     | —<br>7.8                        | —<br>1.2                      | —<br>5.0                            | —<br>0.8                          | —<br>4.2                    | —<br>1.0                       | —<br>4.8                      | —<br>5.4                      | —<br>4.2                             | —                                     | —                                | —                                 | 1:17.52<br>1:3.13            | —<br>0.2                         | —  |
| Scott <sup>(11)</sup> ..                                 | 6 M., F.                 | 14.75                               | 16.00                                | 15.70                                  | 13.05                        | 4.50                            | 1.77                          | 3.72                                | 0.10                              | 0.80                        | 0.87                           | 10.85                         | 2.73                          | 12.58                                | 1.95                                  | 0.43                             | 0.07                              | 1:4.65                       | —                                | —  |

<sup>1</sup> Including histiocytes. (a) Maximum. (b) Minimum. <sup>2</sup> These figures are taken from Table I. <sup>3</sup> M. = Male. <sup>4</sup> Standard deviation. <sup>5</sup> M.F. = Male and female.

significance of the difference between each set of means was being estimated.

Table III also contains the blood and marrow findings in ten of the cases of thyrotoxicosis two to three weeks after operation. The means of these figures do not differ significantly from those in the same ten cases, or indeed from those in all the 31 cases, before operation. No cytological abnormalities were seen in the cells of the blood or marrow of the thyrotoxic patients, nor were changes found in the appearance and distribution of the red marrow of the subjects examined *post mortem*. Although the liver and other organs displayed some lymphocytic infiltration, as is usual in thyrotoxicosis, no other evidence of extra-medullary hæmopoiesis was found in the fatal cases.

The blood and bone marrow of a myxœdematous patient, aged sixty-seven years, were examined. Total thyroidectomy had been performed two years previously, but she had not continued to take her thyroid tablets. On her admission to hospital her basal metabolic rate was -26%; with the exhibition of thyroxin this figure eventually rose to +18%. On her admission to hospital the hæmoglobin value was 8.6 grammes per centum, and the erythrocytes numbered 3,460,000 per cubic millimetre. The leucocytes numbered 8,650 per cubic millimetre; 62.5% were neutrophile polymorphonuclear cells, 9% were old metamyelocytes, 3% were eosinophile cells and 25.5% were lymphocytes. Bone marrow obtained by sternal puncture and aspiration on three successive days contained less than 19,000 cells per cubic millimetre. A differential count of the marrow cells showed that 11.5% were neutrophile polymorphonuclear cells, 24.0% were old metamyelocytes, 6.8% were young metamyelocytes, 4.1% were myelocytes, 1.1% were premyelocytes, 0.2% were myeloblasts, 1.5% were eosinophile cells, 0.6% were basophile cells, 8.5% were lymphocytes, 40.0% were normoblasts, 1.3% were late erythroblasts, and 0.4% were early erythroblasts.

#### Experimental Methods and Results.

Forty-one albino rats weighing between 275 and 328 grammes were used for experiments I and II and as controls. Seventeen albino rats aged between twenty and twenty-six days were used for experiment III. Six litter mates of these seventeen animals were included in the control series. All rats were apparently healthy, there being no evidence of respiratory or other infections. The animals were fed on the same standard diet, and an excess of food and water was always available. During the period of observation each animal was weighed at least once a fortnight. Male animals only were used, as Emmel and Walker<sup>(9)</sup> have shown that variations in the blood occur in the rat during the œstrus cycle.

The specimens of blood were obtained by warming and clipping the tail. The same pipettes and counting chambers were used throughout. The reticulocytes were vitally stained with cresyl blue by collecting the blood directly onto a prepared slide, drying and counterstaining with Leishman's stain. The platelets were estimated by Wright and Kinnicutt's method.<sup>(10)</sup> The bone marrow was obtained by splitting the right femur and removing the marrow more or less intact. For sectioning, the marrow was fixed in Helly's fluid and prepared as described in a previous communication,<sup>(11)</sup> with the exception that decalcification was unnecessary. Smears of the marrow were prepared by emulsification in serum. (At first rat serum was used, but because of its tedious preparation and because no difference could be detected in smears prepared with human serum, the latter was used for most of the specimens.) After emulsification the marrow was spun down and smears were made from the deposit. These were stained by Leishman's stain. For the differential counts on the peripheral blood 200 cells were counted. For the marrow smears two groups of 500 cells were counted for each of the control rats, and one group of 500 cells was counted for each of the other rats.

As far as possible the same nomenclature has been used for the cells of the blood and bone marrow of the rat as for human cells. There are slight differences, however, in the morphology of the cells of man and the rat. In the peripheral blood of the rat most of the eosinophile cells contain ring-shaped nuclei and the granules of the basophile cells are finer and more numerous. The most noticeable differences between the bone marrow of the rat and that of man are that the former contains primitive cells of the granular series with irregular and ring-shaped nuclei, smaller megakaryocytes, and mast cells packed with large, intensely blue granules. An excellent description of the marrow cells of the albino rat has been given by Stasney and Higgins.<sup>(12)</sup>

Eighteen adult rats were chosen as the control series, and the blood and bone marrow from them was examined.

Table IV contains a summary of reports from the literature of the blood and marrow findings in healthy albino rats, together with a summary of the results from my own series. The details of the counts for the latter series are given in Table V. Duplicate differential counts of 500 cells each were made on the marrow films from the control rats, and the values of the significant differences between two films have been calculated according to Mainland.<sup>(13)</sup> These figures are also included in Table V.

TABLE III.  
*Blood and Bone Marrow Findings in Adult Thyrotoxic Patients.*

[illegible]

TABLE IV.  
Summary of Blood and Bone Marrow Counts on Normal Albino Rats.

| Author.  | Number of Rats. | Sex of Rats. | Blood.                               |   |                                 |  |                                     |                               |                             |                                     |                                   |   | Bone Marrow.                        |                                  |                              |                                 |                               |                                     |                                   |  |                                |                               |                               |                                      |                                   |                                  |                                 |
|--|-----------------|--------------|--------------------------------------|---|---------------------------------|--|-------------------------------------|-------------------------------|-----------------------------|-------------------------------------|-----------------------------------|---|-------------------------------------|----------------------------------|------------------------------|---------------------------------|-------------------------------|-------------------------------------|-----------------------------------|--|--------------------------------|-------------------------------|-------------------------------|--------------------------------------|-----------------------------------|----------------------------------|---------------------------------|
|  |                 |              | Hemoglobin.<br>(Grammes per Centum.) | Erythrocytes. (Millions<br>per Cubic Millimetre.) | Reticulocytes.<br>(Percentage.) | Leucocytes. (Thousands<br>per Cubic Millimetre.) | Neutrophile Cells.<br>(Percentage.) | Lymphocytes.<br>(Percentage.) | Monocytes.<br>(Percentage.) | Eosinophile Cells.<br>(Percentage.) | Basophile Cells.<br>(Percentage.) | Platelets. (Thousands<br>per Cubic Millimetre.) | Neutrophile Cells.<br>(Percentage.) | Metamyelocytes.<br>(Percentage.) | Myelocytes.<br>(Percentage.) | Promyelocytes.<br>(Percentage.) | Myeloblasts.<br>(Percentage.) | Eosinophile Cells.<br>(Percentage.) | Basophile Cells.<br>(Percentage.) | Monocytes.<br>(Percentage.) <sup>1</sup> | Plasma Cells.<br>(Percentage.) | Lymphocytes.<br>(Percentage.) | Normoblasts.<br>(Percentage.) | Late Erythroblasts.<br>(Percentage.) | Mitotic Figures.<br>(Percentage.) | Megakaryocytes.<br>(Percentage.) | Ratio of Red to<br>White Cells. |
| Wilson <sup>1</sup> —<br>Mean<br>S.D. <sup>2</sup>                 | 18              | M.           | 14.84<br>1.05                        | 8.67<br>0.59                                      | 1.23<br>0.56                    | 9.67<br>3.60                                     | 23.14<br>8.55                       | 74.25<br>8.59                 | 0.86<br>1.03                | 2.25<br>1.79                        | 0.08<br>0.19                      | 386.81<br>112.15                                | 1.27<br>0.92                        | 43.55<br>6.92                    | 3.30<br>1.50                 | 0.81<br>0.74                    | 0.25<br>0.32                  | 3.82<br>1.55                        | 0.49<br>0.32                      | 0.09<br>0.11                             | 2.39<br>0.92                   | 1.56<br>1.19                  | 41.44<br>7.76                 | 0.20<br>0.31                         | 0.71<br>0.26                      | 0.18<br>0.20                     | 1:1.55<br>1:0.62                |
| Higgins<br>and Stan-<br>ney <sup>(100)</sup> —<br>Mean<br>S.D. . . | 36              | ?            | 16.90<br>0.21                        | 9.18<br>1.01                                      | 1.2<br>0.49                     | 14.20<br>6.08                                    | 21.80<br>5.46                       | 69.70<br>6.46                 | 3.70<br>2.79                | 3.70<br>2.47                        | 0.85<br>0.93                      | 961<br>165                                      |                                     |                                  |                              |                                 |                               |                                     |                                   |  |                                |                               |                               |                                      |                                   |                                  |                                 |
| Stanney<br>and Hig-<br>gins <sup>(101)(102)</sup>                  | 24              | ?            |                                      |   |                                 |  |                                     |                               |                             |                                     |                                   |   | 33.0                                | 4.8                              | 7.6                          | 4.5                             | 5.4 <sup>3</sup>              | 7.0                                 | —                                 | —  | —                              | 1.5                           | 35.9                          | —                                    | —                                 | 0.4                              | 1:1.8                           |
| Vaughan<br>and<br>Gunn <sup>(103)</sup>                            | 14              | M.           | 16.4                                 | 9.1   | 1.04                            |  |                                     |                               |                             |                                     |                                   |   |                                     |                                  |                              |                                 |                               |                                     |                                   |  |                                |                               |                               |                                      |                                   |                                  |                                 |
| Brumer<br>et alii <sup>(104)</sup> . .                             | ?               | F.           | 14.9                                 | 9.4   | 2.6                             | 13.5   |                                     |                               |                             |                                     |                                   |   |                                     |                                  |                              |                                 |                               |                                     |                                   |  |                                |                               |                               |                                      |                                   |                                  |                                 |

<sup>1</sup> Including histiocytes.

<sup>2</sup> These figures were taken from Table V.

<sup>3</sup> Including leucoblasts.

<sup>4</sup> S.D. = Standard deviation.

<sup>1</sup> Including histiocytes.<sup>2</sup> These figures were taken from Table V.<sup>3</sup> Including leucoblasts.<sup>4</sup> S.D. = Standard deviation.TABLE V.  
Blood and Bone Marrow Counts on Normal Albino Rats.

| Blood.   |                           |                                   |  |                              |   |                                 |                            |                          |                                 |                               | Bone Marrow.                                 |                                 |                               |                           |                              |                            |                                 |                               |                                       |                             |                            |                            |                                   |                                |                               |                              |
|--|---------------------------|-----------------------------------|--|------------------------------|---|---------------------------------|----------------------------|--------------------------|---------------------------------|-------------------------------|--|---------------------------------|-------------------------------|---------------------------|------------------------------|----------------------------|---------------------------------|-------------------------------|---------------------------------------|-----------------------------|----------------------------|----------------------------|-----------------------------------|--------------------------------|-------------------------------|------------------------------|
| Number of Rat.   | Weight of Rat. (Grammes.) | Hemoglobin. (Grammes per Centum.) | Erythrocytes. (Millions per Cubic Millimetre.) | Reticulocytes. (Percentage.) | Leucocytes. (Thousands per Cubic Millimetre.) | Neutrophil Cells. (Percentage.) | Lymphocytes. (Percentage.) | Monocytes. (Percentage.) | Eosinophil Cells. (Percentage.) | Basophil Cells. (Percentage.) | Platelets. (Thousands per Cubic Millimetre.) | Neutrophil Cells. (Percentage.) | Metamyelocytes. (Percentage.) | Myelocytes. (Percentage.) | Premyelocytes. (Percentage.) | Myeloblasts. (Percentage.) | Eosinophil Cells. (Percentage.) | Basophil Cells. (Percentage.) | Monocytes. <sup>1</sup> (Percentage.) | Plasma Cells. (Percentage.) | Lymphocytes. (Percentage.) | Normoblasts. (Percentage.) | Late Erythroblasts. (Percentage.) | Mitotic Figures. (Percentage.) | Megakaryocytes. (Percentage.) | Ratio of Red to White Cells. |
| 1  | 300                       | 12.5                              | 7.3  | 1.5                          | 10.1  | 22.5                            | 76.0                       | —                        | 1.5                             | —                             | 402  | 0.0                             | 41.5                          | 4.0                       | —                            | —                          | 3.4                             | —                             | —                                     | —                           | —                          | —                          | —                                 | —                              | —                             | 1:1.1                        |
| 2  | 278                       | 16.8                              | 9.1  | 1.9                          | 14.6  | 38.0                            | 69.0                       | —                        | 2.5                             | 0.5                           | 296  | 0.0                             | 45.5                          | 4.0                       | —                            | —                          | 6.0                             | —                             | —                                     | —                           | —                          | —                          | —                                 | —                              | —                             | 1:1.9                        |
| 3  | 286                       | 13.6                              | 8.2  | 0.8                          | 10.4  | 17.5                            | 77.5                       | 1.5                      | 3.5                             | —                             | 347  | 0.4                             | 54.2                          | 1.6                       | —                            | —                          | 4.4                             | —                             | 0.4                                   | 0.12                        | —                          | —                          | —                                 | —                              | —                             | 1:1.3                        |
| 4  | 285                       | 15.2                              | 8.9  | 1.4                          | 4.9   | 6.0                             | 93.0                       | —                        | 1.0                             | —                             | 365  | 0.4                             | 59.4                          | 12.2                      | —                            | 0.12                       | 5.2                             | —                             | 0.4                                   | 0.12                        | 1.4                        | 12.0                       | 28.8                              | —                              | —                             | 1:2.5                        |
| 5  | 285                       | 14.1                              | 8.4  | 1.3                          | 4.7   | 31.5                            | 60.0                       | 1.0                      | 7.0                             | 0.5                           | 540  | 1.12                            | 45.4                          | 4.8                       | 0.4                          | 0.12                       | 4.2                             | —                             | 0.4                                   | 0.12                        | 1.4                        | 12.0                       | 42.0                              | —                              | —                             | 1:1.4                        |
| 6  | 280                       | 15.6                              | 9.3  | 2.0                          | 6.7   | 14.5                            | 85.5                       | —                        | —                               | —                             | 298  | 0.02                            | 45.2                          | 3.2                       | 0.6                          | 0.12                       | 5.2                             | —                             | 0.4                                   | —                           | —                          | —                          | 47.0                              | —                              | —                             | 1:1.1                        |
| 7  | 290                       | 15.0                              | 8.9  | 1.7                          | 7.8   | 30.0                            | 68.5                       | —                        | 1.5                             | —                             | 445  | 1.2                             | 47.2                          | 2.6                       | 0.4                          | 0.12                       | 4.2                             | —                             | —                                     | 1.0                         | —                          | —                          | 42.8                              | —                              | —                             | 1:1.3                        |
| 8  | 275                       | 15.2                              | 9.8  | 0.5                          | 11.0  | 15.0                            | 83.0                       | —                        | 2.0                             | —                             | 305  | 3.4                             | 48.1                          | 6.0                       | 0.2                          | 0.4                        | 6.2                             | —                             | 0.12                                  | —                           | —                          | —                          | 33.6                              | —                              | —                             | 1:1.9                        |
| 9  | 270                       | 16.5                              | 8.8  | 2.1                          | 10.6  | 30.5                            | 66.0                       | —                        | 3.5                             | —                             | 219  | 0.6                             | 42.4                          | 5.4                       | 0.2                          | 0.4                        | 6.8                             | —                             | 0.4                                   | —                           | —                          | —                          | 38.8                              | —                              | —                             | 1:1.6                        |
| 10   | 275                       | 14.4                              | 8.5  | 1.5                          | 17.2  | 32.5                            | 64.5                       | 1.0                      | 1.5                             | 0.5                           | 635  | 3.2                             | 55.8                          | 6.6                       | 1.2                          | 0.4                        | 6.8                             | —                             | 0.4                                   | —                           | —                          | —                          | 34.0                              | —                              | —                             | 1:1.7                        |
| 11   | 300                       | 14.2                              | 8.5  | 1.2                          | 6.1   | 20.5                            | 78.0                       | —                        | 1.5                             | —                             | 530  | 2.4                             | 46.2                          | 1.8                       | 0.2                          | 0.4                        | 6.4                             | —                             | —                                     | 0.4                         | —                          | —                          | 37.8                              | —                              | —                             | 1:2.5                        |
| 12   | 282                       | 14.9                              | 8.6  | 1.0                          | 7.2   | 30.0                            | 65.5                       | 2.0                      | 2.5                             | —                             | 336  | 0.8                             | 46.6                          | 1.6                       | 0.4                          | 0.4                        | 6.2                             | —                             | —                                     | 0.4                         | —                          | —                          | 55.4                              | —                              | —                             | 1:1.8                        |
| 13   | 315                       | 15.2                              | 9.2  | 0.8                          | 12.5  | 18.0                            | 80.5                       | 1.5                      | —                               | —                             | 414  | 1.2                             | 44.2                          | 1.2                       | 0.4                          | 0.4                        | 6.8                             | —                             | —                                     | 0.12                        | —                          | —                          | 57.6                              | —                              | —                             | 1:0.82                       |
| 14   | 310                       | 14.8                              | 9.0  | 1.0                          | 12.2  | 17.5                            | 70.0                       | —                        | 3.5                             | —                             | 326  | 0.8                             | 39.8                          | 1.4                       | 0.6                          | 0.4                        | 6.4                             | —                             | —                                     | 0.12                        | —                          | —                          | 40.0                              | —                              | —                             | 1:0.71                       |
| 15   | 284                       | 13.8                              | 8.8  | 0.6                          | 8.7   | 21.0                            | 78.0                       | 0.5                      | 0.5                             | —                             | 390  | 1.4                             | 31.0                          | 0.2                       | 0.6                          | 0.4                        | 6.8                             | —                             | —                                     | 0.6                         | —                          | —                          | 46.0                              | —                              | —                             | 1:1.5                        |
| 16   | 285                       | 13.8                              | 8.4  | 1.0                          | 4.7   | 19.5                            | 77.0                       | 1.5                      | 2.0                             | —                             | 540  | 1.2                             | 45.0                          | 1.2                       | 0.4                          | 0.12                       | 6.8                             | —                             | —                                     | 0.6                         | —                          | —                          | 51.4                              | —                              | —                             | 1:1.2                        |
| 17   | 275                       | 15.5                              | 9.8  | 0.4                          | 11.0  | 24.0                            | 68.0                       | 3.0                      | 5.0                             | —                             | 293  | 1.2                             | 46.4                          | 1.0                       | 0.4                          | 0.4                        | 6.8                             | —                             | —                                     | 0.12                        | —                          | —                          | 47.4                              | —                              | —                             | 1:0.93                       |
| 18   | 305                       | 16.0                              | 8.5  | 0.6                          | 13.6  | 28.0                            | 67.5                       | 3.5                      | 1.5                             | —                             | 278  | 1.2                             | 49.0                          | 0.8                       | 0.6                          | 0.4                        | 6.8                             | —                             | —                                     | 0.12                        | —                          | —                          | 43.6                              | —                              | —                             | 1:0.91                       |
|  |                           |                                   |  |                              |   |                                 |                            |                          |                                 |                               |  | 1.2                             | 46.4                          | 1.0                       | 0.4                          | 0.4                        | 6.8                             | —                             | —                                     | 0.12                        | —                          | —                          | 43.6                              | —                              | —                             | 1:1.7                        |
|  |                           |                                   |  |                              |   |                                 |                            |                          |                                 |                               |  | 0.6                             | 44.0                          | 0.8                       | 0.6                          | 0.4                        | 6.8                             | —                             | —                                     | 0.12                        | —                          | —                          | 43.6                              | —                              | —                             | 1:1.3                        |
|  |                           |                                   |  |                              |   |                                 |                            |                          |                                 |                               |  | 0.2                             | 40.8                          | 0.8                       | 0.4                          | 0.4                        | 6.8                             | —                             | —                                     | 0.12                        | —                          | —                          | 43.6                              | —                              | —                             | 1:1.2                        |
|  |                           |                                   |  |                              |   |                                 |                            |                          |                                 |                               |  | 1.0                             | 28.4                          | 7.2                       | 1.0                          | 2.0                        | 6.8                             | —                             | —                                     | 0.12                        | —                          | —                          | 43.6                              | —                              | —                             | 1:0.89                       |
|  |                           |                                   |  |                              |   |                                 |                            |                          |                                 |                               |  | 1.2                             | 34.0                          | 1.8                       | 0.4                          | 0.4                        | 6.8                             | —                             | —                                     | 0.12                        | —                          | —                          | 43.6                              | —                              | —                             | 1:1.1                        |
|  |                           |                                   |  |                              |   |                                 |                            |                          |                                 |                               |  | 0.4                             | 40.6                          | 3.2                       | 0.4                          | —                          | 6.8                             | —                             | —                                     | —                           | —                          | —                          | 43.6                              | —                              | —                             | 1:0.96                       |
| Mean   |                           | 14.84                             | 8.67   | 1.23                         | 9.67  | 23.14                           | 74.25                      | 0.86                     | 2.25                            | 0.08                          | 386.8  | 1.27                            | 43.55                         | 3.30                      | 0.81                         | 0.25                       | 3.82                            | 0.49                          | 0.09                                  | 2.39                        | 1.56                       | 41.44                      | 0.20                              | 0.71                           | 0.18                          | 1:1.55                       |
| Standard deviation   |                           | 1.05                              | 0.59   | 0.56                         | 3.60  | 8.55                            | 8.59                       | 1.03                     | 1.79                            | 0.19                          | 112.1  | 0.92                            | 6.92                          | 1.50                      | 0.74                         | 0.32                       | 1.55                            | 0.32                          | 0.11                                  | 0.92                        | 1.19                       | 7.76                       | 0.31                              | 0.26                           | 0.20                          | 1:0.62                       |
| Significant difference between two films, vide Maitland, <sup>(100)</sup> page 215 |                           |                                   |  |                              |   |                                 |                            |                          |                                 |                               |  | 1.55                            | 13.47                         | 3.19                      | 1.50                         | 1.02                       | 3.00                            | 0.69                          | 0.42                                  | 1.40                        | 2.67                       | 14.75                      | 0.99                              | 0.72                           | 0.47                          | 1:1.67                       |

<sup>1</sup> Including histiocytes.

<sup>1</sup> M.C. Hb. = Mean corpuscular hemoglobin. <sup>2</sup> M.C. Vol. = Mean corpuscular volume. <sup>3</sup> M.C. Hb. C. = Mean corpuscular hemoglobin concentration. <sup>4</sup> Expressed as a percentage of normal. <sup>5</sup> Expressed as a percentage above normal. <sup>6</sup> Expressed as a percentage below normal. <sup>7</sup> Expressed as a percentage of normal. <sup>8</sup> Expressed as a percentage above normal. <sup>9</sup> Expressed as a percentage below normal. <sup>10</sup> Expressed as a percentage of normal. <sup>11</sup> Expressed as a percentage above normal. <sup>12</sup> Expressed as a percentage below normal. <sup>13</sup> Expressed as a percentage of normal. <sup>14</sup> Expressed as a percentage above normal. <sup>15</sup> Expressed as a percentage below normal. <sup>16</sup> Expressed as a percentage of normal. <sup>17</sup> Expressed as a percentage above normal. <sup>18</sup> Expressed as a percentage below normal. <sup>19</sup> Expressed as a percentage of normal. <sup>20</sup> Expressed as a percentage above normal. <sup>21</sup> Expressed as a percentage below normal. <sup>22</sup> Expressed as a percentage of normal. <sup>23</sup> Expressed as a percentage above normal. <sup>24</sup> Expressed as a percentage below normal. <sup>25</sup> Expressed as a percentage of normal. <sup>26</sup> Expressed as a percentage above normal. <sup>27</sup> Expressed as a percentage below normal. <sup>28</sup> Expressed as a percentage of normal. <sup>29</sup> Expressed as a percentage above normal. <sup>30</sup> Expressed as a percentage below normal. <sup>31</sup> Expressed as a percentage of normal. <sup>32</sup> Expressed as a percentage above normal. <sup>33</sup> Expressed as a percentage below normal. <sup>34</sup> Expressed as a percentage of normal. <sup>35</sup> Expressed as a percentage above normal. <sup>36</sup> Expressed as a percentage below normal. <sup>37</sup> Expressed as a percentage of normal. <sup>38</sup> Expressed as a percentage above normal. <sup>39</sup> Expressed as a percentage below normal. <sup>40</sup> Expressed as a percentage of normal. <sup>41</sup> Expressed as a percentage above normal. <sup>42</sup> Expressed as a percentage below normal. <sup>43</sup> Expressed as a percentage of normal. <sup>44</sup> Expressed as a percentage above normal. <sup>45</sup> Expressed as a percentage below normal. <sup>46</sup> Expressed as a percentage of normal. <sup>47</sup> Expressed as a percentage above normal. <sup>48</sup> Expressed as a percentage below normal. <sup>49</sup> Expressed as a percentage of normal. <sup>50</sup> Expressed as a percentage above normal. <sup>51</sup> Expressed as a percentage below normal. <sup>52</sup> Expressed as a percentage of normal. <sup>53</sup> Expressed as a percentage above normal. <sup>54</sup> Expressed as a percentage below normal. <sup>55</sup> Expressed as a percentage of normal. <sup>56</sup> Expressed as a percentage above normal. <sup>57</sup> Expressed as a percentage below normal. <sup>58</sup> Expressed as a percentage of normal. <sup>59</sup> Expressed as a percentage above normal. <sup>60</sup> Expressed as a percentage below normal. <sup>61</sup> Expressed as a percentage of normal. <sup>62</sup> Expressed as a percentage above normal. <sup>63</sup> Expressed as a percentage below normal. <sup>64</sup> Expressed as a percentage of normal. <sup>65</sup> Expressed as a percentage above normal. <sup>66</sup> Expressed as a percentage below normal. <sup>67</sup> Expressed as a percentage of normal. <sup>68</sup> Expressed as a percentage above normal. <sup>69</sup> Expressed as a percentage below normal. <sup>70</sup> Expressed as a percentage of normal. <sup>71</sup> Expressed as a percentage above normal. <sup>72</sup> Expressed as a percentage below normal. <sup>73</sup> Expressed as a percentage of normal. <sup>74</sup> Expressed as a percentage above normal. <sup>75</sup> Expressed as a percentage below normal. <sup>76</sup> Expressed as a percentage of normal. <sup>77</sup> Expressed as a percentage above normal. <sup>78</sup> Expressed as a percentage below normal. <sup>79</sup> Expressed as a percentage of normal. <sup>80</sup> Expressed as a percentage above normal. <sup>81</sup> Expressed as a percentage below normal. <sup>82</sup> Expressed as a percentage of normal. <sup>83</sup> Expressed as a percentage above normal. <sup>84</sup> Expressed as a percentage below normal. <sup>85</sup> Expressed as a percentage of normal. <sup>86</sup> Expressed as a percentage above normal. <sup>87</sup> Expressed as a percentage below normal. <sup>88</sup> Expressed as a percentage of normal. <sup>89</sup> Expressed as a percentage above normal. <sup>90</sup> Expressed as a percentage below normal. <sup>91</sup> Expressed as a percentage of normal. <sup>92</sup> Expressed as a percentage above normal. <sup>93</sup> Expressed as a percentage below normal. <sup>94</sup> Expressed as a percentage of normal. <sup>95</sup> Expressed as a percentage above normal. <sup>96</sup> Expressed as a percentage below normal. <sup>97</sup> Expressed as a percentage of normal. <sup>98</sup> Expressed as a percentage above normal. <sup>99</sup> Expressed as a percentage below normal. <sup>100</sup> Expressed as a percentage of normal.

*Experiment I.*

Blood was collected for examination from eleven adult rats. The skin of the neck of the rats was shaved, and under "open" anaesthesia thyroidectomy was performed. No attempt was made to attain asepsis; in no animal did a serious wound infection develop. Because of their anatomical position the parathyroid glands were removed with the thyroid gland. The excised tissue was examined microscopically. Five to eight months after operation the rats were killed by opening the thoracic cavity under "open" ether anaesthesia. Blood was collected for examination immediately after anaesthetization. In addition to the femoral marrow, specimens of the heart muscle, suprarenal gland, testis, spleen and liver were removed from most of the rats for the making of sections. These organs were fixed in formal saline solution and the sections were stained with hematoxylin and eosin.

Table VI contains the results of the blood counts of the eleven adult rats before thyroidectomy together with the results of the blood and marrow counts five to eight months later. These figures showed no significant difference from normal; the cellularity of the femoral marrow was within normal limits, and no pathological change was found in the other organs.

*Experiment II.*

Thyroxin (Roche Products, Limited) was injected intramuscularly into twelve adult rats in doses of one milligramme every two or three days. Blood was collected for examination before the first injection. Two weeks after the last injection the rats were killed; blood, bone marrow

and specimens of other organs were obtained as in experiment I.

The results of the blood examinations are contained in Table VII. After the exhibition of thyroxin the blood of these rats showed no significant change, but the number of myelocytes and of eosinophile cells of the marrow was decreased. The differences of the means of these figures from normal were just outside the usual limits of significance, and may or may not have been due to the thyroxin. It is possible that more significant results would have been obtained if this experiment had been continued for a longer period. In eight of the twelve rats the cellularity of the marrow was slightly increased; in the other four rats the cellularity of the marrow was within normal limits. No change was found in the other organs of these rats. The hypertrophy of the liver and kidneys, which Belasco<sup>(4)</sup> reported, was not detected. The short duration of the experiment may account for this and for the lack of changes in the liver cells, although they have been reported by other authors.

*Experiment III.*

Seventeen young rats were submitted to total thyroidectomy. The excised tissue was examined microscopically. At intervals from four to nine months later these rats were killed. Blood, bone and marrow and specimens of other organs were obtained as in experiment I; but blood counts were not performed on these animals before operation.

The blood counts made at the time of death are shown in Table VIII. The peripheral blood of these rats differed

TABLE VI.  
Blood and Bone Marrow Counts on Adult Rats Subjected to Thyroidectomy.

| Number of Rat.                                 | Weight of Rat at Operation. (Grammes.) | Number of Days between Operation and Autopsy. | Blood.                           |  |                              |   |                                  |                            |                          |                                  |                                |  | Bone Marrow.                     |                               |                           |                              |                            |                                  |                                |                                       |                             |                            |                            |                                   |                                |                               |                              |
|--|--|---|----------------------------------|--|------------------------------|---|----------------------------------|----------------------------|--------------------------|----------------------------------|--------------------------------|--|----------------------------------|-------------------------------|---------------------------|------------------------------|----------------------------|----------------------------------|--------------------------------|---------------------------------------|-----------------------------|----------------------------|----------------------------|-----------------------------------|--------------------------------|-------------------------------|------------------------------|
|  |  |   | Hemoglobin Value. (Grammes.)     | Erythrocytes. (Millions per Cubic Millimetre.) | Reticulocytes. (Percentage.) | Leucocytes. (Thousands per Cubic Millimetre.) | Neutrophile Cells. (Percentage.) | Lymphocytes. (Percentage.) | Monocytes. (Percentage.) | Eosinophile Cells. (Percentage.) | Basophile Cells. (Percentage.) | Platelets. (Thousands per Cubic Millimetre.) | Neutrophile Cells. (Percentage.) | Metamyelocytes. (Percentage.) | Myelocytes. (Percentage.) | Premyelocytes. (Percentage.) | Myeloblasts. (Percentage.) | Eosinophile Cells. (Percentage.) | Basophile Cells. (Percentage.) | Monocytes. (Percentage.) <sup>1</sup> | Plasma Cells. (Percentage.) | Lymphocytes. (Percentage.) | Normoblasts. (Percentage.) | Late Erythroblasts. (Percentage.) | Mitotic Figures. (Percentage.) | Megakaryocytes. (Percentage.) | Ratio of Red to White Cells. |
| 19   | 328                                    | 187   | (a) <sup>1</sup> 16.6<br>(b)14.7 | 9.3<br>8.6                                     | 1.2<br>1.2                   | 12.3<br>7.4                                   | 32.5<br>28.5                     | 62.5<br>64.5               | 0.5<br>—                 | 4.5<br>7.0                       | —                              | 355<br>238                                   | —                                | 45.6                          | 4.2                       | 1.0                          | 0.8                        | 8.2                              | —                              | —                                     | 2.4                         | 1.2                        | 36.0                       | —                                 | 0.6                            | —                             | 1:1.8                        |
| 20   | 325                                    | 187   | (a) 16.2<br>(b) 14.4             | 9.0<br>8.5                                     | 0.8<br>0.6                   | 7.8<br>31.4                                   | 24.0<br>27.5                     | 72.0<br>70.0               | 1.5<br>—                 | 2.5<br>0.5                       | —                              | 445<br>325                                   | 0.6                              | 34.2                          | 3.2                       | 0.8                          | —                          | 5.8                              | 0.4                            | 0.2                                   | 3.6                         | 0.8                        | 40.0                       | 0.4                               | 1.0                            | —                             | 1:1.0                        |
| 21   | 296                                    | 204   | (a) 13.8<br>(b) 13.0             | 8.6<br>8.5                                     | 2.4<br>1.9                   | 6.9<br>10.4                                   | 26.5<br>16.0                     | 69.0<br>80.5               | —                        | 4.0<br>3.5                       | 0.5<br>—                       | 296<br>404                                   | 1.4                              | 28.0                          | 0.8                       | 0.4                          | 0.2                        | 4.2                              | 0.6                            | —                                     | 2.8                         | 2.4                        | 58.6                       | 0.2                               | 0.2                            | 0.2                           | 1:0.69                       |
| 22   | 306                                    | 210   | (a) 13.2<br>(b) 13.8             | 8.5<br>8.8                                     | 2.1<br>1.6                   | 12.2<br>8.7                                   | 30.0<br>30.5                     | 67.0<br>63.5               | —                        | 2.5<br>6.0                       | 0.5<br>—                       | 372<br>419                                   | 0.8                              | 40.6                          | 4.0                       | 1.2                          | 0.2                        | 5.0                              | 0.6                            | —                                     | 3.8                         | 1.0                        | 42.4                       | —                                 | 0.4                            | —                             | 1:1.3                        |
| 23   | 287                                    | 210   | (a) 14.4<br>(b) 14.4             | 8.0<br>8.1                                     | 0.4<br>0.8                   | 8.4<br>13.2                                   | 35.5<br>23.0                     | 60.0<br>75.5               | 2.0<br>0.5               | 1.5<br>1.0                       | 1.0<br>—                       | 456<br>273                                   | 0.8                              | 38.2                          | 2.6                       | 0.2                          | —                          | 2.8                              | 0.2                            | 0.4                                   | 1.6                         | 1.8                        | 51.0                       | —                                 | 0.4                            | —                             | 1:0.95                       |
| 24   | 294                                    | 228   | (a) 13.9<br>(b) 13.8             | 8.8<br>8.8                                     | 1.0<br>1.0                   | 9.2<br>9.6                                    | 21.0<br>23.5                     | 74.5<br>73.0               | 0.5<br>—                 | 3.5<br>3.0                       | 0.5<br>0.5                     | 521<br>400                                   | 2.2                              | 43.4                          | 3.6                       | 0.2                          | —                          | 3.2                              | 0.8                            | 0.2                                   | 2.4                         | 2.0                        | 41.6                       | —                                 | 0.2                            | 0.2                           | 1:1.4                        |
| 25   | 279                                    | 238   | (a) 14.2<br>(b) 14.8             | 9.6<br>9.5                                     | 1.8<br>1.5                   | 13.4<br>15.8                                  | 26.5<br>20.0                     | 71.0<br>73.5               | —                        | 2.5<br>4.5                       | —                              | 353<br>302                                   | 1.0                              | 41.4                          | 2.4                       | 0.6                          | 0.4                        | 1.8                              | 0.4                            | 0.4                                   | 2.0                         | 2.8                        | 45.8                       | 0.2                               | 0.8                            | —                             | 1:1.2                        |
| 26   | 311                                    | 228   | (a) 16.6<br>(b) 16.0             | 9.8<br>9.2                                     | 0.4<br>1.9                   | 11.5<br>7.3                                   | 26.5<br>29.5                     | 69.0<br>67.0               | —                        | 4.5<br>0.5                       | —                              | 425<br>470                                   | 0.4                              | 50.6                          | 0.8                       | —                            | —                          | 4.0                              | 0.2                            | 0.4                                   | 3.0                         | 1.2                        | 38.4                       | —                                 | 0.6                            | 0.4                           | 1:1.6                        |
| 27   | 306                                    | 237   | (a) 15.5<br>(b) 13.8             | 9.4<br>8.2                                     | 0.9<br>1.2                   | 17.5<br>12.0                                  | 19.5<br>32.5                     | 79.5<br>64.5               | —                        | 1.0<br>2.5                       | —                              | 296<br>510                                   | 1.8                              | 39.0                          | 1.2                       | 0.4                          | 0.2                        | 2.6                              | 0.2                            | —                                     | 3.2                         | 1.8                        | 49.4                       | —                                 | —                              | 0.2                           | 1:1.0                        |
| 28   | 283                                    | 237   | (a) 14.2<br>(b) 14.3             | 9.2<br>8.9                                     | 1.3<br>1.0                   | 10.1<br>12.9                                  | 28.0<br>31.5                     | 68.5<br>67.5               | —                        | 3.5<br>1.0                       | —                              | 347<br>284                                   | 1.4                              | 42.8                          | 2.4                       | 0.8                          | 0.2                        | 1.8                              | 0.6                            | 0.2                                   | 4.6                         | 0.6                        | 44.2                       | 0.2                               | 0.2                            | —                             | 1:1.2                        |
| 29   | 294                                    | 252   | (a) 16.0<br>(b) 15.5             | 9.3<br>9.3                                     | 1.0<br>0.8                   | 5.6<br>8.0                                    | 27.0<br>30.0                     | 71.0<br>67.5               | —                        | 2.0<br>2.5                       | —                              | 280<br>412                                   | 1.2                              | 48.6                          | 1.6                       | 0.2                          | —                          | 3.2                              | 0.2                            | —                                     | 2.4                         | 0.6                        | 41.4                       | 0.2                               | 0.4                            | —                             | 1:1.4                        |
| Mean before operation .. Standard deviation .. |  |   | 14.96<br>1.24                    | 9.05<br>0.44                                   | 1.21<br>0.68                 | 10.45<br>3.56                                 | 27.00<br>4.42                    | 69.45<br>5.07              | 0.41<br>0.73             | 2.91<br>1.18                     | 0.23<br>0.36                   | 376.91<br>80.07                              |                                  |                               |                           |                              |                            |                                  |                                |                                       |                             |                            |                            |                                   |                                |                               |                              |
| Mean after operation .. Standard deviation ..  |  |   | 14.46<br>0.82                    | 8.76<br>0.46                                   | 1.30<br>0.69                 | 12.43<br>7.19                                 | 26.59<br>5.02                    | 69.73<br>5.09              | 0.18<br>0.35             | 3.27<br>2.00                     | 0.23<br>0.36                   | 385.18<br>93.44                              | 1.05<br>0.67                     | 41.13<br>6.69                 | 2.44<br>1.28              | 0.53<br>0.40                 | 0.18<br>0.26               | 3.87<br>2.00                     | 0.38<br>0.22                   | 0.16<br>0.19                          | 2.89<br>0.86                | 1.47<br>0.78               | 45.25<br>6.90              | 0.11<br>0.14                      | 0.44<br>0.30                   | 0.09<br>0.14                  | 1:1.23<br>1:0.34             |

<sup>1</sup> Including histiocytes.

<sup>2</sup> (a) Before operation.

<sup>3</sup> (b) After operation.

TABLE VII.  
Blood and Bone Marrow Counts on Adult Rats Injected with Thyroxin.

| Rat Number.                       | Percentage Loss of Weight of Rat. | Dose of Thyroxin. (Milligrammes.) | Period of Administration of Thyroxin. (Days.) | Blood.                            |  |                              |   |                                  |                            |                          |                                  |                                |  | Bone Marrow.                     |                               |                           |                              |                            |                                  |                                |                          |                             |                            |                            |                                   |                                |                               |                              |  |  |  |
|-----------------------------------|-----------------------------------|-----------------------------------|---|-----------------------------------|--|------------------------------|---|----------------------------------|----------------------------|--------------------------|----------------------------------|--------------------------------|--|----------------------------------|-------------------------------|---------------------------|------------------------------|----------------------------|----------------------------------|--------------------------------|--------------------------|-----------------------------|----------------------------|----------------------------|-----------------------------------|--------------------------------|-------------------------------|------------------------------|--|--|--|
|                                   |                                   |                                   |   | Hemoglobin. (Grammes per Centum.) | Erythrocytes. (Millions per Cubic Millimetre.) | Reticulocytes. (Percentage.) | Leucocytes. (Thousands per Cubic Millimetre.) | Neutrophile Cells. (Percentage.) | Lymphocytes. (Percentage.) | Monocytes. (Percentage.) | Eosinophile Cells. (Percentage.) | Basophile Cells. (Percentage.) | Platelets. (Thousands per Cubic Millimetre.) | Neutrophile Cells. (Percentage.) | Metamyelocytes. (Percentage.) | Myelocytes. (Percentage.) | Premyelocytes. (Percentage.) | Myeloblasts. (Percentage.) | Eosinophile Cells. (Percentage.) | Basophile Cells. (Percentage.) | Monocytes. (Percentage.) | Plasma Cells. (Percentage.) | Lymphocytes. (Percentage.) | Normoblasts. (Percentage.) | Late Erythroblasts. (Percentage.) | Mitotic Figures. (Percentage.) | Megakaryocytes. (Percentage.) | Ratio of Red to White Cells. |  |  |  |
| 30                                | 2.7                               | 5                                 | 16  | (a) 15.0<br>(b) 14.2              | 9.0<br>8.1                                     | 1.0<br>1.0                   | 6.1<br>8.0                                    | 39.5<br>20.0                     | 56.5<br>78.5               | 1.5<br>—                 | 2.5<br>1.5                       | —<br>—                         | 368<br>418                                   | 1.8                              | 54.6                          | 3.0                       | 0.4                          | 0.6                        | 2.4                              | 0.2                            | —                        | 3.4                         | 0.6                        | 32.0                       | 0.4                               | 0.4                            | 0.2                           | 1:2.1                        |  |  |  |
| 31                                | 3.3                               | 8                                 | 22  | (a) 14.7<br>(b) 15.2              | 9.1<br>9.0                                     | 2.0<br>1.5                   | 12.4<br>9.7                                   | 34.0<br>34.5                     | 66.0<br>62.5               | —<br>2.0                 | 3.5<br>1.0                       | 0.5<br>—                       | 341<br>463                                   | 2.6                              | 37.4                          | 2.2                       | 0.4                          | 0.4                        | 3.0                              | 0.4                            | —                        | 1.6                         | 1.8                        | 49.0                       | —                                 | 1.2                            | —                             | 1:1.0                        |  |  |  |
| 32                                | 4.7                               | 8                                 | 22  | (a) 14.7<br>(b) 14.8              | 8.8<br>9.1                                     | 0.8<br>2.1                   | 8.1<br>23.6                                   | 22.0<br>20.0                     | 75.0<br>67.5               | 1.0<br>—                 | 2.0<br>3.0                       | —<br>0.5                       | 256<br>206                                   | 3.2                              | 43.6                          | 1.4                       | 0.6                          | —                          | 1.8                              | 0.8                            | —                        | 1.4                         | 3.2                        | 43.0                       | —                                 | 1.0                            | —                             | 1:1.3                        |  |  |  |
| 33                                | 3.2                               | 8                                 | 18  | (a) 14.8<br>(b) 14.2              | 8.2<br>8.0                                     | 1.8<br>2.2                   | 7.4<br>9.4                                    | 26.5<br>33.5                     | 71.0<br>63.0               | 1.5<br>2.0               | 1.0<br>1.5                       | —<br>—                         | 438<br>392                                   | 0.4                              | 29.4                          | 4.6                       | 0.2                          | 0.2                        | 3.4                              | —                              | —                        | 2.6                         | 4.2                        | 54.2                       | 0.2                               | 0.4                            | 0.2                           | 1:0.83                       |  |  |  |
| 34                                | 4.0                               | 8                                 | 16  | (a) 14.7<br>(b) 14.7              | 8.6<br>8.5                                     | 1.6<br>2.4                   | 10.1<br>12.5                                  | 29.5<br>23.5                     | 69.5<br>75.5               | 0.5<br>—                 | 0.5<br>1.0                       | —<br>—                         | 384<br>362                                   | 3.0                              | 33.8                          | 2.4                       | 0.2                          | —                          | 2.0                              | 0.2                            | 0.4                      | 1.2                         | 0.8                        | 54.8                       | 0.4                               | 0.6                            | 0.2                           | 1:0.80                       |  |  |  |
| 35                                | 5.6                               | 12                                | 30  | (a) 15.2<br>(b) 15.0              | 9.2<br>9.2                                     | 1.0<br>1.0                   | 10.6<br>7.5                                   | 21.0<br>27.5                     | 74.5<br>70.0               | —<br>0.5                 | 4.0<br>2.0                       | 0.5<br>—                       | 294<br>317                                   | 1.4                              | 49.6                          | 2.2                       | —                            | —                          | 2.6                              | 0.2                            | 0.2                      | 3.4                         | 0.4                        | 38.6                       | 0.4                               | 1.0                            | —                             | 1:1.5                        |  |  |  |
| 36                                | 4.3                               | 12                                | 26  | (a) 14.6<br>(b) 14.2              | 8.8<br>8.5                                     | 1.2<br>2.0                   | 7.6<br>12.9                                   | 28.0<br>31.5                     | 69.5<br>66.0               | 1.0<br>—                 | 1.5<br>2.5                       | —<br>—                         | 428<br>365                                   | 2.2                              | 42.0                          | 0.6                       | 0.2                          | —                          | 3.4                              | 0.6                            | —                        | 2.6                         | 0.8                        | 47.2                       | —                                 | 0.2                            | 0.2                           | 1:1.1                        |  |  |  |
| 37                                | 2.5                               | 12                                | 26  | (a) 13.8<br>(b) 14.0              | 8.9<br>8.9                                     | 1.4<br>1.2                   | 8.7<br>8.2                                    | 24.5<br>25.0                     | 72.0<br>73.0               | —<br>0.5                 | 3.0<br>1.5                       | 0.5<br>—                       | 227<br>414                                   | 0.4                              | 51.8                          | 0.4                       | —                            | 0.2                        | 1.2                              | 0.2                            | —                        | 1.4                         | 3.2                        | 39.8                       | 0.6                               | 0.4                            | 0.4                           | 1:1.5                        |  |  |  |
| 38                                | 4.0                               | 15                                | 29  | (a) 14.6<br>(b) 14.2              | 9.1<br>9.0                                     | 1.0<br>0.8                   | 13.6<br>9.8                                   | 22.5<br>27.5                     | 74.5<br>70.0               | —<br>—                   | 2.0<br>2.5                       | 1.0<br>—                       | 349<br>343                                   | 2.0                              | 47.6                          | 1.6                       | —                            | —                          | 1.6                              | 1.0                            | 0.4                      | 1.8                         | 0.6                        | 42.4                       | 0.2                               | 0.8                            | —                             | 1:1.3                        |  |  |  |
| 39                                | 3.7                               | 15                                | 29  | (a) 14.2<br>(b) 13.4              | 8.7<br>8.2                                     | 1.2<br>1.6                   | 9.9<br>14.3                                   | 26.0<br>21.5                     | 72.5<br>76.5               | 0.5<br>—                 | 1.0<br>1.5                       | —<br>0.5                       | 361<br>332                                   | 0.8                              | 50.2                          | 2.0                       | 0.4                          | —                          | 2.0                              | 0.4                            | —                        | 0.8                         | 2.2                        | 40.8                       | —                                 | 0.2                            | 0.2                           | 1:1.4                        |  |  |  |
| 40                                | 5.1                               | 15                                | 29  | (a) 15.6<br>(b) 15.6              | 9.6<br>9.8                                     | 2.2<br>1.4                   | 10.2<br>10.1                                  | 20.0<br>32.0                     | 77.0<br>65.5               | 2.5<br>0.5               | 0.5<br>2.0                       | —<br>—                         | 423<br>285                                   | 0.6                              | 59.4                          | 0.8                       | 0.6                          | 0.2                        | 2.6                              | 0.2                            | 0.2                      | 2.4                         | 1.4                        | 30.8                       | 0.2                               | 0.6                            | —                             | 1:2.2                        |  |  |  |
| 41                                | 3.6                               | 15                                | 29  | (a) 14.2<br>(b) 13.8              | 8.8<br>8.9                                     | 0.8<br>1.4                   | 15.5<br>11.4                                  | 31.0<br>24.5                     | 65.5<br>74.5               | —<br>—                   | 3.5<br>1.0                       | —<br>—                         | 407<br>392                                   | 1.4                              | 42.2                          | 0.8                       | —                            | —                          | 3.0                              | 0.2                            | 0.2                      | 1.0                         | 1.6                        | 49.4                       | —                                 | 0.2                            | —                             | 1:1.0                        |  |  |  |
| Mean before injection of thyroxin |                                   |                                   |   | 14.68                             | 8.90   | 1.33                         | 10.02   | 26.71                            | 70.04                      | 0.71                     | 2.08                             | 0.21                           | 356.33                                       |                                  |                               |                           |                              |                            |                                  |                                |                          |                             |                            |                            |                                   |                                |                               |                              |  |  |  |
| Standard deviation                |                                   |                                   |   | 0.44                              | 0.35   | 0.50                         | 2.40  | 5.68                             | 5.84                       | 0.84                     | 1.17                             | 0.35                           | 70.85  |                                  |                               |                           |                              |                            |                                  |                                |                          |                             |                            |                            |                                   |                                |                               |                              |  |  |  |
| Mean after course of thyroxin     |                                   |                                   |   | 14.44                             | 8.60   | 1.55                         | 11.45   | 27.50                            | 70.21                      | 0.46                     | 1.75                             | 0.08                           | 349.25                                       | 1.65                             | 45.13                         | 1.83                      | 0.25                         | 0.13                       | 2.42                             | 0.37                           | 0.12                     | 1.97                        | 1.75                       | 43.50                      | 0.20                              | 0.58                           | 0.12                          | 1:1.94                       |  |  |  |
| Standard deviation                |                                   |                                   |   | 0.76                              | 0.55   | 0.55                         | 4.55  | 4.71                             | 5.64                       | 0.80                     | 0.69                             | 0.64                           | 78.75  | 1.02                             | 9.15                          | 1.20                      | 0.24                         | 0.21                       | 0.74                             | 0.30                           | 0.16                     | 0.89                        | 1.30                       | 9.44                       | 0.22                              | 0.37                           | 0.14                          | 1:0.44                       |  |  |  |

\* Including histiocytes.

\* (a) Before injection of thyroxin.

\* (b) After injection of thyroxin.

TABLE VIII.  
Blood and Bone Marrow Counts on Cretin Rats.

| Rat Number.        | Age of Rat. (Days.) | Weight of Rat. (Grammes.) | Blood.                            |  |                              |   |                                  |                            |                          |                                  |                                |  |                                  |                               | Bone Marrow.              |                              |                            |                                  |                                |                          |                             |                            |                            |                                   |                                |                               |                              |
|--------------------|---------------------|---------------------------|-----------------------------------|--|------------------------------|---|----------------------------------|----------------------------|--------------------------|----------------------------------|--------------------------------|--|----------------------------------|-------------------------------|---------------------------|------------------------------|----------------------------|----------------------------------|--------------------------------|--------------------------|-----------------------------|----------------------------|----------------------------|-----------------------------------|--------------------------------|-------------------------------|------------------------------|
|                    |                     |                           | Hemoglobin. (Grammes per Centum.) | Erythrocytes. (Millions per Cubic Millimetre.) | Reticulocytes. (Percentage.) | Leucocytes. (Thousands per Cubic Millimetre.) | Neutrophile Cells. (Percentage.) | Lymphocytes. (Percentage.) | Monocytes. (Percentage.) | Eosinophile Cells. (Percentage.) | Basophile Cells. (Percentage.) | Platelets. (Thousands per Cubic Millimetre.) | Neutrophile Cells. (Percentage.) | Metamyelocytes. (Percentage.) | Myelocytes. (Percentage.) | Premyelocytes. (Percentage.) | Myeloblasts. (Percentage.) | Eosinophile Cells. (Percentage.) | Basophile Cells. (Percentage.) | Monocytes. (Percentage.) | Plasma Cells. (Percentage.) | Lymphocytes. (Percentage.) | Normoblasts. (Percentage.) | Late Erythroblasts. (Percentage.) | Mitotic Figures. (Percentage.) | Megakaryocytes. (Percentage.) | Ratio of Red to White Cells. |
| 42                 | 130                 | 114                       | 11.3                              | 7.5  | 1.5                          | 6.5   | 44.5                             | 55.5                       | —                        | —                                | —                              | 396  | 0.6                              | 31.0                          | 2.2                       | 0.6                          | 0.2                        | 2.8                              | 0.2                            | —                        | 1.0                         | —                          | 59.4                       | —                                 | 0.8                            | —                             | 1:0.67                       |
| 43                 | 130                 | 120                       | 11.4                              | 8.0  | 1.0                          | 6.9   | 21.0                             | 77.5                       | —                        | —                                | —                              | 354  | 1.0                              | 46.12                         | 4.4                       | 0.6                          | 1.0                        | 4.6                              | 1.4                            | —                        | —                           | —                          | 36.4                       | —                                 | 0.8                            | —                             | 1:1.7                        |
| 44                 | 151                 | 118                       | 8.6                               | 7.3  | 1.6                          | 6.8   | 42.0                             | 52.0                       | 0.5                      | 5.5                              | —                              | 298  | 1.0                              | 41.4                          | 3.4                       | —                            | —                          | 3.0                              | 0.2                            | —                        | —                           | —                          | 49.0                       | —                                 | 0.4                            | —                             | 1:1.0                        |
| 45                 | 151                 | 126                       | 11.8                              | 7.9  | 0.7                          | 9.4   | 19.0                             | 79.0                       | 0.5                      | 1.0                              | —                              | 345  | 0.2                              | 51.6                          | 0.8                       | —                            | —                          | 4.0                              | 0.5                            | —                        | —                           | —                          | 41.4                       | —                                 | 0.2                            | —                             | 1:1.4                        |
| 46                 | 158                 | 124                       | 11.2                              | 6.6  | 1.2                          | 9.4   | 35.5                             | 60.0                       | —                        | —                                | —                              | 452  | 0.4                              | 54.8                          | 2.2                       | 0.6                          | —                          | 0.4                              | 1.6                            | 31.8                     | —                           | —                          | 41.4                       | —                                 | 0.2                            | —                             | 1:1.2                        |
| 47                 | 158                 | 124                       | 11.6                              | 6.5  | 1.0                          | 6.5   | 49.0                             | 48.0                       | —                        | —                                | —                              | 375  | 0.4                              | 45.2                          | 2.2                       | 0.8                          | —                          | 10.0                             | 0.8                            | 0.6                      | 1.6                         | 4.4                        | 29.6                       | —                                 | 0.4                            | —                             | 1:2.3                        |
| 48                 | 158                 | 200                       | 13.5                              | 7.2  | 0.2                          | 15.4  | 31.5                             | 65.0                       | 2.0                      | 1.5                              | —                              | 247  | 0.2                              | 38.6                          | 4.0                       | —                            | —                          | 11.8                             | 0.2                            | 0.2                      | —                           | —                          | 41.6                       | —                                 | 0.6                            | —                             | 1:1.4                        |
| 49                 | 161                 | 103                       | 10.9                              | 6.8  | 0.5                          | 5.7   | 37.0                             | 55.5                       | 0.5                      | 6.0                              | 1.0                            | 483  | —                                | 39.2                          | 1.0                       | —                            | —                          | 4.0                              | 0.6                            | —                        | —                           | —                          | 54.4                       | —                                 | —                              | —                             | 1:0.83                       |
| 50                 | 161                 | 118                       | 12.4                              | 7.9  | 1.2                          | 6.4   | 46.0                             | 49.5                       | 1.0                      | 3.5                              | —                              | 461  | 1.0                              | 30.3                          | 1.0                       | —                            | —                          | 1.6                              | 0.4                            | 0.2                      | —                           | —                          | 61.6                       | —                                 | 0.2                            | —                             | 1:0.62                       |
| 51                 | 161                 | 95                        | 9.5                               | 7.4  | 0.4                          | 7.9   | 33.5                             | 59.0                       | 1.5                      | 5.5                              | 0.5                            | 398  | 0.6                              | 49.4                          | 0.4                       | —                            | —                          | 12.0                             | 0.2                            | —                        | —                           | —                          | 45.2                       | —                                 | 0.6                            | —                             | 1:1.2                        |
| 52                 | 208                 | 126                       | 10.4                              | 6.4  | 0.4                          | 11.4  | 34.0                             | 63.0                       | —                        | —                                | —                              | 297  | 1.2                              | 59.3                          | 0.8                       | 0.2                          | —                          | 2.6                              | 0.2                            | —                        | —                           | —                          | 31.0                       | —                                 | 0.4                            | —                             | 1:2.2                        |
| 53                 | 208                 | 92                        | 9.5                               | 6.3  | 1.0                          | 10.3  | 34.5                             | 49.5                       | 1.5                      | 4.5                              | —                              | 416  | 0.4                              | 48.6                          | 1.4                       | 0.4                          | —                          | 2.3                              | 0.8                            | —                        | —                           | —                          | 42.6                       | —                                 | 0.2                            | —                             | 1:1.3                        |
| 54                 | 208                 | 126                       | 8.7                               | 5.2  | 1.3                          | 9.6   | 21.0                             | 76.0                       | —                        | —                                | —                              | 305  | 2.2                              | 40.2                          | 1.0                       | —                            | —                          | 4.2                              | 1.4                            | 1.4                      | 1.4                         | 48.0                       | —                          | 0.2                               | —                              | —                             | 1:1.1                        |
| 55                 | 254                 | 200                       | 11.3                              | 7.3  | 0.7                          | 4.5   | 62.0                             | 35.0                       | 1.0                      | 2.0                              | —                              | 387  | 1.6                              | 44.8                          | 2.6                       | 0.2                          | —                          | 3.6                              | 0.4                            | —                        | —                           | —                          | 44.2                       | —                                 | 0.8                            | —                             | 1:1.2                        |
| 56                 | 254                 | 117                       | 10.2                              | 6.1  | 0.8                          | 13.2  | 29.0                             | 39.5                       | —                        | 1.5                              | —                              | 421  | 0.8                              | 36.4                          | 2.2                       | 0.8                          | 0.4                        | 4.0                              | 0.2                            | —                        | —                           | —                          | 52.8                       | —                                 | 0.2                            | —                             | 1:0.89                       |
| 57                 | 254                 | 124                       | 10.5                              | 7.6  | 2.1                          | 6.0   | 36.5                             | 54.5                       | 3.0                      | 6.0                              | —                              | 394  | —                                | 40.0                          | 7.6                       | 0.8                          | 0.4                        | 9.2                              | 0.6                            | —                        | —                           | —                          | 40.0                       | —                                 | 0.4                            | —                             | 1:1.4                        |
| 58                 | 254                 | 130                       | 10.4                              | 7.8  | 2.0                          | 4.7   | 15.5                             | 84.0                       | —                        | —                                | —                              | 273  | 1.0                              | 44.6                          | 8.2                       | 1.2                          | 1.0                        | —                                | —                              | 2.6                      | 2.0                         | 35.0                       | —                          | —                                 | 0.2                            | —                             | 1:1.8                        |
| Mean               | ..                  | ..                        | 10.78                             | 6.95   | 1.15                         | 8.19  | 37.16                            | 58.97                      | 0.68                     | 3.06                             | 0.15                           | 372.65                                       | 0.74                             | 43.61                         | 2.92                      | 0.32                         | 0.21                       | 4.86                             | 0.49                           | 0.07                     | 0.98                        | 1.40                       | 43.76                      | 0.16                              | 0.31                           | 0.14                          | 1:1.42                       |
| Standard deviation | ..                  | ..                        | 1.27                              | 0.91   | 0.58                         | 3.03  | 13.28                            | 13.81                      | 0.67                     | 1.92                             | 0.29                           | 187.94                                       | 0.58                             | 7.12                          | 2.40                      | 0.40                         | 0.33                       | 2.98                             | 0.39                           | 0.20                     | 0.62                        | 1.14                       | 9.60                       | 0.23                              | 0.27                           | 0.21                          | 1:0.36                       |

\* Including histiocytes.

from that of the control series: the hæmoglobin and erythrocyte levels were considerably lower, the percentage of lymphocytes was decreased, and the percentage of neutrophile cells was increased. The differential counts on the marrow of the cretin rats revealed significant decreases from normal limits in the numbers of premyelocytes, plasma cells and mitotic figures. The cellularity of the marrow of fourteen of these seventeen rats was decreased, whilst the cellularity of the marrow of the other rats was within normal limits. Apart from the impaired rate of growth, examination of other organs of these rats revealed no abnormality. The rate of growth of these cretin rats was greatly diminished; the growth charts of four litter mates, of which three were submitted to thyroidectomy when aged twenty-six days, are shown in Figure I.

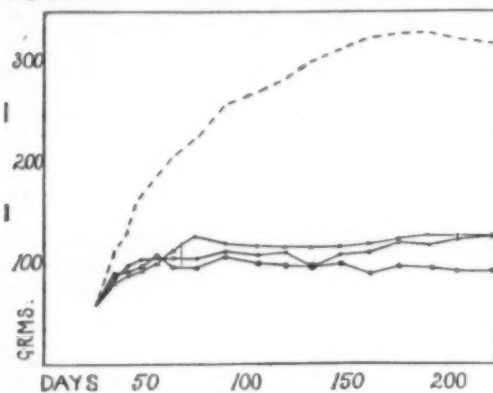


FIGURE I.

The growth charts of four albino rats (litter mates), three of which were subjected to thyroidectomy when aged twenty-eight days. The graph of the control rat is shown as the interrupted line.

#### Discussion.

In a desire to simplify hæmatology and to explain the ætiology of the anemia of hypothyroid conditions, it has often been suggested that thyroxin is necessary for the final stages of maturation of the definitive normoblastic series. The lack of study of the bone marrow in myxœdema and cretinism would seem to signify that we have been content with this suggestion, just as the theory of maturation arrest was accepted as the explanation of the bone marrow changes in pernicious anemia. While there was some justification for accepting that theory in pernicious anemia (the abundance of megaloblasts which, with liver therapy, become replaced by normoblasts made this theory quite plausible), there are insufficient grounds for the belief that thyroxin plays a specific part in the maturation of the normoblast.

On the latter hypothesis an increase in the primitive cells of the normoblastic series of the bone marrow might have been expected in hypothyroidism; yet this has not been described. The accepted pathology of hypothyroidism is that of a hypoplasia affecting all phases of hæmopoiesis.

In hyperthyroidism the increased cellularity of the marrow, together with a normal differential count except for the monocytes, indicates that all the other cells of the marrow are included in the hyperplasia. This can be adduced as evidence of the non-specificity of the action of thyroxin in hæmopoiesis; so also can the fact that thyroxin is necessary for the normal metabolism of the hæmopoietic principle, as shown by the ineffectiveness of liver therapy alone in cases of pernicious anemia complicated by myxœdema.

A more satisfactory theory allots thyroxin a non-specific role in hæmopoiesis. This has been done by Bomford<sup>(1)</sup>; but he suggested that unless there was a complicating iron or liver deficiency, the anemia of hypothyroidism was a

physiological adaptation on the part of the erythron to a diminished need of the tissues for oxygen.

The anemia and the decreased cellularity of the marrow of the cretin rats and of the patient suffering from myxœdema support this hypothesis; against it is the fact that most of the thyrotoxic patients of Table III exhibited mild anemia. Perhaps this was owing to an associated iron deficiency; the majority of these patients were females of the age at which an iron deficiency anemia is common. It will be noticed that the average mean corpuscular hæmoglobin concentration of these patients was near the lower limit of normal. Achlorhydria is common in thyrotoxicosis, and thus an impaired assimilation of iron is likely in this disease.

The increased cellularity of the bone marrow in hyperthyroidism cannot be due solely to a physiological adaptation on the part of the erythron to the increased oxygen requirements of the tissues, for the reason that the cells of the granular series are included in the hyperplasia; also against this theory is the rarity, clinical and experimental, of the association of thyrotoxicosis and polycythemia, even though the basal oxygen requirements are considerably increased by thyrotoxicosis.

The hyperplasia of the cells of the granular series was such as is seen in chronic myeloid leucæmia. The fact that the peripheral blood did not reflect these changes makes the state of affairs analogous to the aleuchemic leucæmic states. The lymphocytic infiltration of the tissues in thyrotoxicosis and the elevated metabolic rate of the leucæmic states also suggests that leucæmia and thyrotoxicosis may not be entirely unrelated. A patient with a non-toxic adenomatous thyroid and chronic myeloid leucæmia has been reported previously (Wilson<sup>(2)</sup>), but I have not observed the coexistence of both thyrotoxicosis and leucæmia in the one patient; nor could the report of such a case be found. Nevertheless, it would be instructive to observe the effect of thyroidectomy on the leucæmia of such a patient.

The coexistence of pernicious anemia and thyrotoxicosis in the one patient has been reported by Meulengracht<sup>(3)</sup> and other authors, but it is possible that such an occurrence is fortuitous, since neither disease is uncommon. *Per contra*, it must be conceded that if true megaloblastic anemia with megaloblastic bone marrow may result from impaired metabolism of the hæmopoietic principle in cirrhosis of the liver (a facile theory which is not proven, Wilson<sup>(4)</sup>), then it is possible that the gross hepatic lesions so frequently associated with thyrotoxicosis may give rise to similar changes in the blood and bone marrow. It might also be postulated that occasionally the interference with the gastric secretion in thyrotoxicosis may be of such a degree that the formation of the intrinsic factor is inhibited.

The absence of changes in the peripheral blood and bone marrow of the adult rats submitted to thyroidectomy is difficult to explain. Perhaps it was due to undetected aberrant thyroid tissue. Incidentally, the existence of aberrant thyroid tissue in any of the rats submitted to operation would vitiate the results in that animal.

To return to the role of the thyroid gland in hæmopoiesis: it is concluded that the thyroid gland exercises a non-specific control of the metabolism of all the marrow cells, resulting in their hyperplasia in thyrotoxicosis and in their hypoplasia in cretinism and myxœdema.

#### Summary.

The blood and bone marrow findings of 31 untreated thyrotoxic patients are reported. Examination of the blood of these patients revealed a mild anemia, and that of the bone marrow an increased cellularity affecting all the cells except the monocytes. It is suggested that this anemia was identical with the secondary hypochromic anemia so often present in middle-aged females and independent of thyrotoxicosis. The increased cellularity of the marrow was not reflected in the peripheral blood. Blood and marrow examinations were repeated on ten of the thyrotoxic patients two to three weeks after operation; but no significant alteration was found.

<sup>1</sup> This problem is discussed elsewhere (Wilson<sup>(2)</sup>).

Apart from mild anaemia and decreased cellularity of the marrow, the blood and marrow findings in a case of myxoedema were within normal limits.

The blood and marrow findings of sixteen young adults are included as a control series.

Small series of young and adult rats were subjected to thyroidectomy, and a series of adult rats were injected with thyroxin. The blood and marrow findings are compared with the figures from a group of normal rats.

The cretin rats developed mild anaemia and relative lymphopenia; the levels of the premyelocytes, plasma cells and mitotic figures of the marrow were significantly lower than normal. The cellularity of the marrow of many of the cretin rats was decreased, whereas that of many of the rats injected with thyroxin was increased and that of the adult thyroidectomized rats was within normal limits. The results observed do not prove that changes are produced in the blood or bone marrow of adult rats by thyroidectomy or by the injection of thyroxin.

Apart from the decreased rate of growth of the cretin rats and the alteration in their bone marrow, no change attributable to the thyroidectomy or to the injection of thyroxin was found in their other organs.

It is concluded that the thyroid gland plays only a non-specific role in haemopoiesis.

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#### References.

- (1) T. Dieterle: "Die Athyreose, unter besonderer Berücksichtigung der dabei auftretenden Skelettveränderungen, sowie die differential-diagnostisch vornehmlich in Betracht kommenden Störungen des Knochenwachstums; Untersuchungen über Thyreoplasie, Chondrodysplasia foetalis und Osteogenesis imperfecta", *Virchows Archiv für pathologische Anatomie und Physiologie und für klinische Medizin*, Volume CLXXXIV, 1906, page 56.
- (2) F. Stoccarda: "Untersuchungen über die Synchondrosis spheno-occipitalis und den Ossifikationsprozess bei Kretinismus und Athyreose", *Beiträge zur pathologischen Anatomie und zur allgemeinen Pathologie*, Volume LXI, 1916, page 450.
- (3) M. Diwany: "Sternal Marrow Puncture in Children", *Archives of Disease in Childhood*, Volume XV, 1940, page 159.
- (4) P. Esser: "Blut und Knochenmark nach Ausfall der Schilddrüsenfunktion; eine klinisch-experimentelle Studie", *Deutsches Archiv für klinische Medizin*, Volume LXXXIX, 1907, page 576.
- (5) A. L. Tatum: "Morphological Studies in Experimental Cretinism", *The Journal of Experimental Medicine*, Volume XVII, 1913, page 636.
- (6) M. M. Kunde, M. F. Green and G. Burns: "Blood Changes in Experimental Hypo- and Hyper-thyroidism (Rabbit)", *The American Journal of Physiology*, Volume XCIX, 1931, page 469.
- (7) R. Bomford: "Anaemia in Myxoedema: and the Role of the Thyroid Gland in Erythropoiesis", *The Quarterly Journal of Medicine*, Volume VII, New Series, 1938, page 495.
- (8) R. M. Jones: "Human Sternal Marrow in Hyperthyroid and Myxoedematous States", *Proceedings of the Society for Experimental Biology and Medicine*, Volume XLI, 1939, page 55.
- (9) L. R. Limarzi: "The Diagnostic Value of Sternal Marrow Aspirations", *Illinois Medical Journal*, Volume LXXV, 1939, page 38.
- (10) A. S. Jackson: "The Blood Picture in Six Hundred Cases of Goiter", *The Journal of the American Medical Association*, Volume XCVII, 1931, page 1954.
- (11) T. Kocher: "Blutuntersuchungen bei Morbus Basedowii mit Beiträgen zur Frühdiagnose und Theorie der Krankheit", *Archiv für klinische Chirurgie*, Volume LXXXVII, 1908, page 131.
- (12) E. P. McCullagh and J. H. Dunlap: "The Blood Picture in Hyperthyroidism and in Hypothyroidism", *The Journal of Laboratory and Clinical Medicine*, Volume XVII, 1932, page 1060.
- (13) S. Hertz and J. Lerman: "The Blood Picture in Exophthalmic Goitre and its Changes Resulting from Iodine and Operation: A Study by Means of the Supravital Technique", *The Journal of Clinical Investigation*, Volume XI, 1932, page 1179.
- (14) R. Gottlieb: "Blood Studies in Hyperthyroidism", *The Journal of Laboratory and Clinical Medicine*, Volume XIX, 1934, page 371.
- (15) H. Zondek and A. Kaatz: "Hormonal Regulation of the Number of Blood Platelets in the Blood", *British Medical Journal*, Volume II, 1936, page 387.
- (16) P. Woodruff: "The Behaviour of the Blood Platelets in Thyrotoxicosis", *The Medical Journal of Australia*, August 31, 1940, page 190.
- (17) R. M. Jones: "Human Sternal Bone Marrow in Hyperthyroid and Myxoedematous States", *The American Journal of the Medical Sciences*, Volume CC, 1940, page 211.
- (18) R. K. S. Lim, B. B. Sarkar and J. P. H. Graham Brown: "The Effect of Thyroid Feeding on the Bone Marrow of Rabbits", *The Journal of Pathology and Bacteriology*, Volume XXV, 1922, page 228.
- (19) A. E. Adams and F. Skevket: "The Normal Blood Picture of White Rats and Changes in the Picture following Thyroid Feeding", *Physiological Zoology*, Volume II, 1929, page 181.
- (20) T. E. Wilson: "The Galactose Tolerance Test in Thyrotoxicosis", *The Medical Journal of Australia*, January 10, 1942, page 33.
- (21) H. R. G. Poate, R. Bartholomew and T. E. Wilson: "The Hippuric Acid Test in Thyrotoxicosis", *The Medical Journal of Australia*, May 29, 1943, page 481.
- (22) J. H. Wright and R. Kinnicutt: "A New Method of Counting the Blood Platelets for Clinical Purposes and Some of the Results Obtained with it", *The Journal of the American Medical Association*, Volume LVI, 1911, page 1457.
- (23) W. W. Duke: "The Relation of Blood Platelets to Hemorrhagic Disease", *The Journal of the American Medical Association*, Volume LV, 1910, page 1185.
- (24) R. I. Lee and P. D. White: "A Clinical Study of the Coagulation Time of the Blood", *The American Journal of the Medical Sciences*, Volume CLXV, 1913, page 495.
- (25) A. J. Quick: "The Nature of the Bleeding in Jaundice", *The Journal of the American Medical Association*, Volume CX, 1938, page 1658.
- (26) T. E. Wilson: "The Bone Marrow in Anaemia", *The Medical Journal of Australia*, May 2, 1942, page 513.
- (27) C. Price-Jones, J. M. Vaughan and H. M. Goddard: "Haematological Standards of Healthy Persons", *The Journal of Pathology and Bacteriology*, Volume XL, 1935, page 503.
- (28) E. Segerdahl: "Über sternal Punktionen", *Acta Medica Scandinavica*, Volume LXIV, 1935, page 1.
- (29) N. G. Nordenson: "Studies on Bone Marrow from Sternal Puncture", 1935.
- (30) R. H. Young and E. E. Osgood: "Sternal Marrow Aspirated during Life", *Archives of Internal Medicine*, Volume LV, 1935, page 189.
- (31) R. B. Scott: "Sternal Puncture in the Diagnosis of Diseases of the Blood-Forming Organs", *The Quarterly Journal of Medicine*, Volume VIII, New Series, 1939, page 137.
- (32) R. A. Fisher: "Statistical Methods for Research Workers", 1938, page 177.
- (33) V. E. Emmel and J. E. Walker: "The Percentage of Polychromasia in the Blood of the Rat as Correlated with Gestation, Lactation and the Gestrous Cycle", *The Anatomical Record*, Volume XXIII, 1922, page 17.
- (34) T. E. Wilson: "Sternal Biopsy", *The Medical Journal of Australia*, March 23, 1940, page 405.
- (35) J. Stasney and G. M. Higgins: "A Quantitative Cytological Study of the Bone Marrow of the Adult Albino Rat", *The Anatomical Record*, Volume LXIII, 1935, page 77.
- (36) G. M. Higgins and J. Stasney: "The Peripheral Blood in Experimental Cirrhosis of the Liver", *Folia Haematologica*, Volume LIV, 1936, page 129.
- (37) G. M. Higgins and J. Stasney: "Changes in the Bone Marrow and Peripheral Blood following Splenectomy in White Rats: Preliminary Report", *Proceedings of the Staff Meetings of the Mayo Clinic*, Volume XI, 1936, page 446.
- (38) S. L. Vaughan and F. D. Gunn: "Bone Marrow Reactions", *The Anatomical Record*, Volume XLIV, 1930, page 335.
- (39) H. D. Bruner, J. van de Erve and A. J. Carlson: "The Blood Picture of Rats from Birth to Twenty-four Days of Age", *The American Journal of Physiology*, Volume CXXIV, 1928, page 620.
- (40) D. Mainland: "The Treatment of Clinical and Laboratory Data", 1938, page 215.
- (41) I. J. Belasco: "The Effect of Thyroxin and Thyrotropic Hormone on Liver and Kidney Tissue Respiration of Rats of Various Ages", *Endocrinology*, Volume XXVIII, 1941, page 153.
- (42) E. Meulengracht: "Morbus Basedowii und perniziöse Anämie", *Klinische Wochenschrift*, Volume VIII, 1929, page 18.

#### INDUSTRIAL MEDICINE.<sup>1</sup>

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THE subject for discussion tonight is industrial medicine. Industrial medicine embraces more than industrial maladies. It means the occupational medicine of people at work and it is, above all else, the industrial branch of preventive medicine directed to the preservation of good health in industry. If employment sickness occurs, then in a sense, industrial medicine has failed. Employment, at one time or another, may subject a worker to a host of chemical, physical and mental hazards with which nearly

<sup>1</sup> Read at a meeting of the New South Wales Branch of the British Medical Association on November 25, 1943.

all doctors are unfamiliar. Industrial medicine is a branch of our professional work which is only gradually receiving the attention it deserves, but which has been much in the minds of leading government medical officers, labour union leaders and insurance companies. About twenty years ago the Director-General, Commonwealth Department of Health, moved to establish a division of industrial hygiene under the late Dr. D. G. Robertson, who is not forgotten by those who knew him. Unfortunately, after a splendid beginning, the division was swept away during the financial depression. At about the same time another landmark was the appointment of the late Dr. C. Badham as Medical Officer to the Division of Industrial Hygiene of the New South Wales Department of Public Health. Under his inspiring leadership Dr. Badham's department has made notable contributions to industrial medicine, and he made his services freely available for consultation and advice. Another famous team already prominent at that time, particularly in the realm of dust fibrosis of the lungs, was that consisting of Dr. S. A. Smith, the late Professor Chapman and the late Dr. W. A. Edwards. Next came the *Workers' Compensation Act* of 1926, which secured compensation to workers for employment injury, and predetermined in New South Wales the course of industrial medicine along legal channels within the scope of this act.

Practitioners of industrial medicine consist mainly of a few doctors working for insurance companies and factories; some work whole time, some part time. Consultants from the specialties in medicine are called in to give expert advice on various problems. Since the present war, however, a new nourishment for industrial medicine is being furnished by industry direct. Industry here is beginning to appreciate that it will profit by the help of medical advisers in regard to working conditions and factory hazards.

On the employees' side, claims for compensation for injury arising out of employment are set in motion for hearing before the courts by a special organization set up at the Trades Hall. Medical men examine claimants and possibly give evidence before the courts. Shop and union committees, organized by workers within the factories, operate in this field by seeking to improve working conditions. There is activity, too, before the arbitration courts, in reference to rates of pay and hours of work. Medical men are occasionally called upon to give expert evidence here; but one's impression is that at present such evidence does not carry the weight it deserves. Insurance companies consult medical men in much the same way as does the employees' representative in regard to claims before the courts. They also endeavour to protect themselves against loss in workers' compensation awards by preventing injury, excellent work being done in this field by safety engineers. Medical and other experts are also called in by insurance companies to visit factories and give advice in regard to possible hazards in handling toxic substances. Some insurance companies also maintain clinics where medical men attend to persons injured at work, and although the practice is opposed by many, these doctors become highly skilled and fill a need at the moment. Industry, too, occasionally employs medical men to attend its personnel, mainly in the matter of minor injuries, while larger organizations may provide good industrial medical service. Many factories rely on their insurer to provide the medical and legal service to help them out of trouble. In some factories one observes failure to provide comfortable facilities for changing and storing street clothes, washing and having a meal. In such factories government inspectors and insurance companies have great difficulty in securing protection for workers, since conditions may not comply with statutory requirements. Industry has made only light calls upon our services, and this is because only now has the realization come that there is a duty not to injure a person at work, and that the worker is worthy of far better treatment than has been his lot in the past. The average person needs to be guided along proper paths in the broader principles of living, and this applies inside the factory, too. Contentment comes with stable employment under safe working conditions.

We medical practitioners should do whatever we can to help the attainment of this goal.

The practice of industrial medicine sometimes requires teamwork to a greater degree than any other branch of medicine. It may at times require the cooperation of chemist, physicist or engineer and doctor. Consider the problem of possible hazard from benzol vapor; a chemist is required to investigate the atmosphere, a physician to examine the patient and a hæmatologist to investigate the blood. Finally, an engineer may be required to protect the worker by efficient ventilation.

The medical practitioner's relation to industry may be of one of three varieties: (i) part time, as a general practitioner attending factories in his district in addition to his ordinary practice; (ii) whole time, as a works (private or government) doctor or as an insurance company doctor; (iii) as a specialist.

#### The General Practitioner and Industry.

The general practitioner, we would all agree, carries the major burden in medicine. He has to bear with the everyday worries of his patients. Many of these arise truly or supposedly out of his employment. Would it not be a great help to him if he followed his patients into the factories and saw them at work? Would it not be a gain to the whole community if every factory was required to have a regular inspection by a doctor practising in the district? From the ranks of the general practitioners come, or should come, the specialists, and the training of future specialists in industrial medicine could well be started in this way. There is a lot to be learned from intangibles, such as the general demeanour and air of workers, showing whether they are working well or loafing, whether they are contented or otherwise. By visiting different factories we learn standards of comparison in regard to noise, cleanliness, lighting, agreeable temperature and general comforts. A practitioner's duty is to supervise the health of the workers. He should inspect the whole of the factory and draw attention to shortcomings. A medical examination card should be drawn up, essential findings recorded at an initial examination and later progress noted. There should be close and sympathetic cooperation with the first-aid attendant. When safety is in question, the management will refer to the doctor, who will know with whom to consult further if he is in doubt, or when the problem requires some technical procedure such as the estimation of a dust hazard.

At the present time a few doctors visit factories in their districts. For the most part such injured people as they see come to their house surgery, or when emergencies or serious accidents occur a factory is visited.

Doctors are pestered for certificates by people seeking a change in working conditions, and rightly accepting the patients' statements, they give such certificates. Would it not be better for all such certificates to be issued by the doctor attending the factory, or in consultation with him?

The question may arise whether the general practitioner would be willing to undertake this work to a greater extent than at present. Before a decision against it is made, one would urge the need for and the attractiveness of this work. The role would be preventive medicine—and what a pleasant relaxation to meet healthy people at work!

#### The Whole-Time Factory Doctor.

Quite a number of doctors are employed for the whole time in government or private establishments. The work is somewhat different from that of the general practitioner, a more advanced grade of industrial medicine being practised. Usually such a doctor's time becomes almost completely occupied with routine work of the nature of the casualty surgeon. He works alone, and does not meet his colleagues in the district, nor is there an industrial medical section of the Branch to correlate his work with that of others in the same field. His position, except in a few organizations which know his worth, is not secure. Even in these organizations his activities are effectively limited. For some unknown reason, lack of confidence in his specialized medical training, plus an unwillingness to

admit him to knowledge of the innermost secrets of factory management, limit his usefulness. His position in an organization should be so secure as to allow workers to apply confidently to him to adjust their wrongs. His work should build up such a tradition of honesty and reliability that management and employees alike could leave in his hands the settling of disputes relating to health matters. We want honourable peace in industry.

At the present time the doctor as a rule plays a minor part in regard to settling disputes about health matters in industry. The lawyers have secured the key positions for themselves, pronouncing upon hours and conditions of work after possibly hearing one or two medical witnesses, who are cross-examined to give a double meaning to their words. There are several notable exceptions to this practice, in Kalgoorlie and in Broken Hill particularly, where medical men have justified themselves as honest adjudicators. A colleague suggested that medical men should be given an opportunity to find peace in the coal-mining industry. Psychological difficulties are interwoven with the other medical problems in industry, and it is the medical man, trained in industry, who should be asked to handle industrial disputes. The main difficulty is in securing the confidence of organized Labour in the industrial medical officer, and to this end he should be a part of the management, yet independent, and should also be in close touch with the labour unions. It is desirable that he should meet union representatives for discussions and give talks to workers on health matters. Other whole-time practitioners in industrial medicine are insurance company doctors, who have supplied the need for special skill in treating accident casualties met with in industry. There is a need for their services owing to the present neglect of industry and of the profession generally to provide the sort of service these men give. The insurance companies have shown enterprise in this matter—far more than have employees' organizations. Why should not the unions provide this service, too, if they so desired?

#### Specialists in Industrial Medicine.

Specialists can speak for themselves. Almost all are needed and used in industry, but not nearly so much as they should be. Specialists should also be educated to the industrial viewpoint, because industrial diseases in a specialty often require wide experience in correct interpretations. We lack the ordinary facilities that are provided on a large scale for ordinary medicine. We lack, as has been pointed out by a colleague, basic training in methods, research institutions, libraries and hospitals for the care of industrial casualties. A legal friend recently discovered provision in the *Workers' Compensation Act* of the power to use funds for the rehabilitation of injured men; but so far as he knew, no such rehabilitation had been attempted. At present an injured worker is paid his lawful compensation and left to shift for himself; the law has finished, but medicine has apparently not been invited to try rehabilitation. Finally, let me utter a plea to psychiatrists to interest themselves in industry. There is need for medical practitioners in this specialty to interest themselves in industry in advising young people on the work for which they are fitted. One is told that it is not possible. At any rate, physical disabilities could be discovered, and all other factors could be given due weight in an assessment. Psychiatrists should have charge of investigation of temperament in order to secure harmony amongst people in industry.

#### Industrial Maladies.

Industrial medicine is concerned with three types of injury: (i) injuries for which employment is wholly responsible, such as oil dermatitis, lead poisoning, silicosis or baker's asthma; (ii) injuries for which employment is partly responsible by aggravation, such as rupture of an aortic aneurysm, pulmonary tuberculosis or peptic ulcer; (iii) injuries in which employment plays but a doubtful role, such as cerebro-spinal fever, newgrowth, coronary occlusion and myocardial degeneration. It is from the two last classes that the most interesting cases come for consideration by the workers' compensation courts.

#### *Fibrotic Diseases of the Lungs due to Dust: The Pneumonokonioses.*

Dust is one of the most common causes of industrial maladies. It may be the cause of upper respiratory tract disability, as in chronic rhinitis due to chromate dust, of lung injury as in silicosis and asbestosis, of general intoxication as in lead or cadmium poisoning and of bronchial asthma as after long exposure to flour dust. Inhalation is of far greater importance than ingestion as a mode of intoxication.

In New South Wales a differentiation between silicosis and pneumonokoniosis has been created, so that compensation claims in cases of the former disease are considered by the Silicosis Commission, and of the latter by the Workers' Compensation Commission. Silicosis is common in Sydney, owing to the fact that many men have been employed for some years in extensive tunnelling through sandstone. Silica in the lung excites a specific reaction in the form of a nodule formation throughout the lungs. It does not cause intoxication, and quite often advanced silicosis remains unsuspected until an X-ray picture is taken. It is quite another matter when secondary infection of the lung supervenes—often tuberculosis. Silicosis concerns us as a diagnostic problem in which the industrial history and X-ray examination are paramount, and for assessment of disability. The latter is far more difficult than the former, and, one must confess, is at present lacking a convenient yardstick such as is available for the assessment of diseases affecting the blood or the kidneys. Clinically, we have no reliable means for measuring the loss of efficiency of the lungs through silicosis.

Pneumonokoniosis in New South Wales usually means dust fibrosis of the lungs in coal-miners. Pneumonokoniosis is a generalized fibrosis of the type of a foreign-body reaction with some nodulation due to silica. It supervenes in coal-miners after twenty to thirty years' work, and causes some shortness of breath. Here again, assessment of incapacity is the main problem, and is arrived at after careful general examination to bring to light other possible causes of incapacity, by consideration of the X-ray films, the reaction to exercise and the history.

The assessment of dust hazards is a most interesting part of our work. Dust samples have to be collected on slides for examination and counting under the oil-immersion lens of the microscope. Larger samples must be taken from the atmosphere for chemical analysis, and the time of exposure of a worker to the dust must be carefully calculated. When a dust hazard is detected, ventilation engineers are required to remove it. Only rarely should recourse to masks be had.

#### *Heart Disease in Industry.*

The pathology of ordinary degenerative heart disease is nowadays much better understood. It is seen as a fibrotic reaction in the myocardium following coronary insufficiency, offset to some extent by the opening-up of rudimentary arterial pathways to compensate for the sclerosed arteries. This is a process which is doubtless going on in every one of us, interrupted now and again by the occurrence of an event—a severe occlusion. A large artery is suddenly blocked, and severe heart shock takes place. Ischaemia occurs and a large infarct is formed, which with the patient's survival becomes an area of fibrotic degeneration. It has been said in the law courts that hard work aggravates chronic heart disease. I do not think that anyone would deny that hard work would inevitably aggravate inflammatory heart disease—rheumatic heart disease. In regard to degenerative heart disease secondary to coronary insufficiency, we must admit that a severe strain beyond the worker's ordinary work efforts may precipitate an abnormal rhythm. It may also be possible that severe and prolonged effort may precipitate a patch of ischaemic fibrosis due to coronary insufficiency; but I would deny that work less strenuous than to precipitate either of these events is harmful. In fact, it is suggested that work is beneficial in stimulating the opening-up of new circulatory pathways. This is an important matter in industry, because the average age of workers is increasing, so that many with degenerative heart disease are included.

### Volatile Solvents.

Solvents are a potent cause of trouble in Sydney, both by reason of their action on the skin, causing dermatitis, and by reason of their action on the body systems generally.

**Benzol or Benzene.**—Benzol or benzene is the most serious hazard of all because of its high degree of toxicity, its insidious and sometimes delayed action, and the resistance to treatment. There are many users of benzol. It is a highly satisfactory solvent for rubber, shellac, resins and nitro-cellulose and pigments. The mode of entry into the body is by inhalation, usually over a period of several months, after which anaemia is revealed by a deathly pallor; hæmorrhage from the orifices occurs, most frequently from the nose. Blood examination reveals severe red and white cell anaemia. In a severe case the number of red cells may fall to about 1,500,000 per cubic millimetre, and of the white cells to 1,200 per cubic millimetre in a severe case. Almost any type of disordered blood reaction may occur, but the usual type is a macrocytic anaemia with great reduction in the number of white cells. An interesting aspect for consideration is the belief in some quarters that aplastic anaemia may occur for the first time years after exposure to benzol. In using any solvent, one should be certain whether it contains benzol or not.

**Carbon Tetrachloride.**—Carbon tetrachloride is used in medicine for hookworm infestation; in industry it is used in chemical fire extinguishers, as it is non-inflammable. It is a well-known solvent of animal fats, rubber and lacquers, and is commonly used as a "degreaser". Its action on the body resembles that of chloroform; it is a narcotic (that is, a liver and kidney poison).

**Petroleum Products: Benzine.**—Benzine is to be sharply distinguished from benzene, a coal tar derivative. Over-exposure to the vapour may cause acute intoxication like that due to alcohol. Chronic effects are described under the heading of vague ill health.

**Trichlorethylene.**—Trichlorethylene is a well-known "degreaser" and solvent of oils, fats and resins. Inhalation is apt to induce mild intoxication. Chronic effects have been described—various types of nerve injury.

**Action of Solvents on the Human Body.**—Particularly valuable work on the action of solvents on the human subject is being done in America, and is described in *The Journal of Industrial Hygiene and Toxicology*. Many new chemical substances are coming into use, and most of us know very little about some of them. As has been suggested by a chemist, it would be a helpful safeguard if untoward symptoms developing among users of these chemicals could be reported much in the same way as infectious diseases are notified.

### Metals.

Metals interest practitioners of industrial medicine. They commonly enter the body by inhalation of their dusts or fumes, as in the case of lead and cadmium, and they each have a more or less specific action on different systems. At times, however, one may be in doubt as to the purity of the composition of a metal; for example, cadmium may be present with zinc, and lead may occur without being suspected. In a metal worker symptoms and certain signs may occur leading one to suspect a metal poisoning when in fact the condition is really something else. For example, in a lead worker anaemia, stippling of red cells and lassitude may occur when the disease is in fact tuberculosis or diabetes, as one has found. Therefore every person suspected of metal poisoning, or of any other type of poisoning for that matter, should be given a thorough medical examination.

Lead poisoning still occurs in Sydney, mainly in lead battery works, amongst the pasters and mixers. All concerned are much on the lookout for plumbism, and it would be unusual for a person to become badly affected before the condition was discovered. Therefore lead poisoning rarely goes beyond the stage of pain in abdomen, constipation, and a persistently high number of stippled cells, with the hæmoglobin level at about 12 grammes per

100 cubic centimetres. A microcytic type of anaemia occurs. The red cells are slightly diminished in number, the mean corpuscular volume is slightly reduced, but the mean corpuscular hæmoglobin concentration is not usually reduced. One has found no use for iron therapy nor for iodides; but a diet rich in vitamins is thought to be of use with milk in treatment.

Arsenic poisoning sometimes occurs by inhalation of dust. General weakness occurs, associated with symptoms of an anæsthetic type of neuritis affecting the glove and stocking areas and with loss of tendon reflexes. Sodium thiosulphate, 15 grains three times a day, may be of value. Injection of vitamin B<sub>12</sub> in large dosage is advisable.

Cadmium is being used extensively. Poisoning may arise from inhalation of fumes during welding of cadmium-plated parts. Symptoms of intestinal irritation occur, and possibly bronchitis also.

Manganese is used extensively in the steel industry. The ores are ground, and if manganese dust is inhaled in sufficient amount, degeneration of the basal ganglia is apt to occur with signs and symptoms resembling disseminated sclerosis or *paralysis agitans*.

Vanadium is also much used in the steel industry. One has had experience after a brief exposure to the dust of a rather intense bronchiolitis a few hours later. It is said that prolonged exposure causes symptoms of intoxication of a more general nature.

Zinc affects solderers and smelters. Chills and sweats cause mild incapacity; but in addition, one has observed after long exposure chronic effects of the nature of intestinal upsets with symptoms suggesting achlorhydria. An alimentary hypersensitivity to zinc seems to be acquired, as one has found, and it becomes necessary to guard these people from exposure to zinc.

### Dermatitis.

Skin affections are, of course, common. They cause alarm to the sufferer and to those working near by. We doctors in general should know more about skin disorders if we are going to be good practitioners in industrial medicine.

Oil dermatitis is a common complaint that should be prevented. It occurs when mineral oils from the machines are allowed to fill the pores of the skin and remain there. On routine fortnightly inspections of machine-shop workers in the shop, one will see the tiny black points of dried oil in the skin. This contains an aromatic material which promotes folliculitis. Upon this, superadded infection from the back of the neck or elsewhere supervenes and oil dermatitis appears. Our job is to prevent the complaint by regular inspections with hand lens, insistence on scrubbing the pores clean and the use of barrier creams.

Paronychia is much like oil dermatitis in the principles of its origin and prevention. Workers with fruit and vegetable juices have their hands moist with fruit juices. We have thus a splendid medium for the growth of bacteria and fungus types of organisms—sugar, warmth and moisture. If any small trauma occurs to the nail bed, destroying the sealing off provided by nature (many women deliberately produce this for beauty's sake), one has conditions suitable for paronychia. Prevention is by regular inspections, and if necessary, by the sealing off of nail beds with a suitable paint.

All the phases of allergy are of tremendous importance to industrial medicine, and particularly in skin work. If we are not familiar with this aspect of our work, we shall be less successful practitioners than we ought to be.

### Industrial Treatment Officers and Dressing Stations.

Just as a radiologist requires a technician in his work, so does medicine in industry need industrial treatment officers. At present qualified nurses and trained and partly trained first-aid workers carry on with the routine work of casualty stations. These nurses and first-aid workers have not available to them any systematic training in their future work in industry, and it is urged that they be given such training, plus official status in their own organizations and remuneration commensurate with their work.

The dressing station should be planned on a more ambitious scale than is usually the case. A waiting room should be provided to keep the treatment room clear, both for better work and for privacy. Wide glass jars, with mouths equally wide and fitted with loose aluminium covers, should be provided for dressings. Ample equipment should be provided, even to ultra-violet and infra-red lamps in certain large establishments. At Maribyrnong an X-ray plant was installed, and when one revisited the establishment about three years ago one was told that about 5,000 X-ray pictures were taken per year.

#### Conclusion.

In conclusion, one would say that we doctors, for the most part, have not been invited to provide for industry the medical service which it should have. Orthopaedic surgeons and dermatologists have been better appreciated. There has been, of course, full enlistment of doctors for the specialized branches of naval, military and aviation medicine, and special courses of instruction are provided for these; but what about doctors for industry? Governments have harped upon the subject of the munitions front, essential war workers and so on; but it has been left to the unaided practitioners to provide similar service for industry. Let us practitioners of medicine resolve to interest ourselves in industrial medicine—go into the factories in the districts where we practice, and, gaining in experience and training as we go, take upon ourselves the whole care of the health of factory workers.

### Reports of Cases.

#### EPICONDYLITIS: TRAUMATIC RADIO-HUMERAL SYNOVITIS.

By J. C. BELL ALLEN, F.R.C.S. (England),  
Sydney.

THE condition of epicondylitis, commonly known as "tennis elbow", has long presented a difficult problem to the surgeon as regards satisfactory treatment. It can lead to serious incapacity in the patient, this incapacity lasting for months and in some cases for years. The disability caused by the condition frequently debars the sufferer from participating in many forms of sport—for example, tennis and squash rackets—and (what is of more importance from the economic standpoint) may interfere with the performance of his work and necessitate a change of employment. An interesting sidelight comes from an American tennis player, who has informed me that the condition is common among baseball players in the United States of America; most of these men are professionals, and they have been forced to give up their remunerative occupation owing to this disability. This suggests that treatment in America is as unsatisfactory as we have found it here in the past.

In the main, treatment recommended has fallen into two categories: firstly, conservative treatment in the form of physiotherapy and the application of splints and plaster casts, and secondly, various surgical procedures such as manipulation. The results that follow both these forms of treatment have been unsatisfactory, and it is the purpose of this brief communication to advocate a further surgical procedure, which I have found over a small number of cases to give successful results. A short history of seven cases follows.

#### Case I.

R.F.H., aged thirty-seven years, a motor-lorry driver, was examined in July, 1940. He stated that on March 1, 1940, a passing motor-lorry had hit the front wheels of his truck with the hub of its back wheel, spinning the steering wheel on which his left arm was resting. This resulted in a jar of his left elbow. X-ray examination revealed no fracture, and after a short period of rest he returned to work. At the end of a week he was unable to continue his work owing to the pain in the elbow. During the period following his cessation of work until his visit to me in

July, his elbow was manipulated on fourteen occasions without relief, and he still complained of pain over the radio-humeral joint on extension and supination, with tenderness localized to this area. An elbow cage limiting extension was applied, and while he was wearing this the elbow was comfortable. He returned to his occupation, which at the time consisted in shovelling sand; however, he experienced great difficulty in working with his cage in position, owing to the irritation caused by friction under the leather. Consequently it was decided to explore his elbow, and on October 17, 1940, operation was carried out, and some thickened synovial membrane was removed. Convalescence was uneventful, and he returned to work about six weeks later; he has since had no further symptoms.

#### Case II.

A.A., aged thirty-four years, a kitchenman, was examined on October 18, 1940. He said that while lifting the lid of an ice chest two days previously he had experienced pain in the right elbow, which he localized below the external condyle of the humerus. He was given physiotherapy until November 6, 1940, when he returned to work. He reported again on November 14, complaining that he could not carry on with his work on account of the pain in his elbow. Pain and tenderness were localized to the same region. A plaster cast was applied and left in position for about a fortnight without relief, and it was then decided to explore the joint. At operation on December 2, 1940, thickened synovial membrane was removed from the joint. He returned to work on January 17, 1941, and since then has had no further trouble with his elbow.

#### Case III.

A.H., aged fifty-two years, complained that many years previously he had had trouble with his elbow as a result of playing tennis. This condition was diagnosed as "tennis elbow", and he had had to give up the game. Late in 1940 he began to play squash rackets, and within a few weeks his right elbow again became troublesome. In April, 1941, he sustained a fracture of the carpal scaphoid bone, which necessitated a short period of rest from squash rackets. On recovering from the fracture, he resumed squash rackets; but this was immediately followed by a return of the pain in his elbow; his symptoms were localized at the joint line between the head of the radius and the humerus. On June 2, 1942, the joint was explored, and thickened synovial membrane was removed. Since the operation he has been able to indulge in his pastime with no harmful after-effects and has remained symptomless up to the present time.

#### Case IV.

A.T.L., an oxy-welder, aged thirty-five years, was examined on December 4, 1942. He stated that on October 29, 1942, he had tripped and hit his right elbow on an angle iron. He complained that his elbow was becoming more painful, and that he was having difficulty in carrying on with his work. Examination elicited tenderness over the joint line between the head of the radius and the humerus, and over the posterior aspect of the lateral epicondyle. It was thought possible that some adhesions were present following a sprain in the extensor muscle origins from the lateral epicondyle, and this area was injected with procaine, but the symptoms were not relieved. He continued to complain of pain, which was accentuated by extension of the elbow and particularly by gripping with his hand. Exploration of the elbow joint was advised. The patient sought other advice, and he was given three weeks' treatment with infra-red rays; later a plaster cast was applied and left in position for three weeks, without avail. In February, 1943, he was examined by another surgeon, who advised manipulation of his elbow. The patient, however, decided against this, and submitted to operation, which was carried out on February 9, 1943; the joint was explored and thickened synovial membrane removed. His convalescence was interrupted by a hematoma in the wound, but the ultimate result was satisfactory, and he returned to work at the end of March. Since then he has had no further trouble.

#### Case V.

W.T.R., aged fifty-five years, was examined on January 22, 1943; he said that on January 6 he had been pulling a mobile crane with both hands behind him, when the handle suddenly jumped upwards and to the left, wrenching his right elbow; immediately he experienced acute pain, which had been present since that time and had been sufficiently

severe to disturb his sleep. The pain was localized to the joint line between the head of the radius and the humerus, and was produced on extension of the elbow. Tenderness was present in this situation. On January 25 the joint was explored, and considerably thickened synovial membrane was removed. The patient made an uninterrupted recovery, and he returned to work on March 2. He has subsequently remained symptomless.

#### Case VI.

R.F., aged fifty-five years, a coalminer, was examined on March 5, 1943. He said that on January 27, 1943, he had twisted his right elbow while unloading timber, and bumped it against an adjacent skip, experiencing pain in the elbow and loss of power in the hand. This pain had persisted and was still present, particularly on extension, on supination and on gripping with the hand. Tenderness was present over the joint line between the head of the radius and the humerus. The joint was explored on March 13, 1943, and thickened synovial membrane was removed. The patient's subsequent progress was satisfactory and uneventful, and he resumed work on April 15, 1943. He has since remained free of symptoms.

#### Case VII.

E.J.W., aged twenty-eight years, a labourer, was examined on August 18, 1943; he said that four months previously he had fallen from a ladder, with his left arm underneath him. Since that time the elbow had been painful, particularly on gripping with his hand. About two months later a piece of stone fell across the lower part of his arm, his elbow being flexed at the time. He said that since this second accident the condition of his elbow had been much worse, and his disability had been aggravated. Pain was present on supination and on closing his fist. Tenderness was localized to the joint line on the outer side. The joint was explored on August 24, 1943, and thickened synovial membrane was removed. Subsequent progress was uneventful, and he returned to work at the beginning of October.

#### Ætiology.

This condition is traumatic in origin, and may occur in one of two ways: firstly, as a result of trauma when the elbow is in a position of flexion, compression in the radio-humeral joint and a consequent "nipping" of the synovial membrane posteriorly between the two bones being caused; secondly, as a result of a sudden hyperextension of the joint, which may occur in association with a mishit at tennis; this also leads to a nipping of the synovial membrane between the radial head and the capitellum. No doubt a similar occurrence is responsible for the frequency of the condition in baseball; however, I have not in my own practice encountered any cases incurred in this form of sport.

#### Pathology.

The pathology of this condition appears to be to some extent analogous to the cartilage lesion in the knee joint. There exists a distinct synovial fringe, triangular in shape, with its base attached peripherally, and with its free margin extending between the radial head and the capitellum, from the postero-medial angle of the joint forwards to about the centre of the joint anteriorly. I have not seen cartilage present in this fringe, nor have I at operation seen the fringe torn. It appears, however, that this fringe becomes enlarged and thickened as the result of trauma; joint movements cause constant aggravation of the condition, particularly movements of extension and gripping with the hand, which normally lead to an approximation of the head of the radius to the capitellum.

#### Symptoms and Clinical Signs.

The outstanding symptom is pain, which is persistent over long periods of time. This pain is produced by hyperextension, particularly when combined with supination and, as previously mentioned, on gripping with the hand. The elbow is comfortable when the muscles are relaxed and in a flexed position. Physical signs are limited to tenderness, accurately localized to the joint line posteriorly; some muscle wasting is at times present from disuse, and occasionally there is slight limitation of extension—perhaps 5°. None of my patients have shown any evidence of bruising.

#### Treatment.

Numerous forms of treatment have been suggested; these range from those of a more conservative nature, such as treatment by massage, heat, diathermy, the application of plaster, and the wearing of an elbow cage, to such surgical expedients as manipulation under anaesthesia and the more radical one of stripping of the extensor muscle attachments from the dorsum of the lateral epicondyle. From past experience these procedures would appear to be of little avail in effecting an ultimate cure. It is my contention that the correct procedure should be the excision of the enlarged synovial fringe, the nipping of which I believe is responsible for the production of symptoms; it is for a similar reason that a torn cartilage is removed from the knee joint. The results in the seven cases quoted in this paper have been so satisfactory that I feel justified in recommending the adoption of this procedure in obstinate cases of "tennis elbow".

If the foregoing contention is correct—namely, that symptoms are due to chronic trauma of the synovial membrane—it would appear that the name epicondylitis, commonly in use, is both inadequate and misleading; "tennis elbow" is not sufficiently descriptive, as this condition is not infrequently an industrial injury. I would suggest as a more descriptive term "traumatic radio-humeral synovitis", as it more accurately describes the underlying pathological condition.

#### Summary.

Seven cases of traumatic radio-humeral synovitis are recorded, with a brief discussion of the aetiology, symptoms and pathology. A new name is suggested for the condition.

## Reviews.

#### THE DEVELOPMENT OF THE CHILD.

THE distinguishing feature of the second edition of "The Natural Development of the Child", by Agatha H. Bowley, Ph.D., psychologist of the school psychological service at Leicester, is the additional material included in the chapter on children and the war.<sup>1</sup>

Dr. Bowley made a collection of 222 free drawings by children between the ages of four and ten years, and also a number of essays, to see how often the children made reference to the war, when given the chance for free expression. The naive quotations from the essays give a good indication of the features of wartime life that have had the greatest effect on the child mind.

The aim of the book is to give an outline of the normal development of the child from infancy to adolescence, and of the difficulties that are likely to occur, and to give suggestions for their treatment. Feeding difficulties, sleeping habits, toilet training, and thumb-sucking are among the questions dealt with in the infant period.

Language development, motor coordination and development, sense perception, play, and social-emotional development in the pre-school period are all helpfully discussed.

The difficulties likely to occur in the middle years of childhood are classified as backwardness and educational difficulties, delinquency and anti-social behaviour, and anxiety conditions and habit disorders.

While Dr. Bowley has the psychologist's objective attitude towards behaviour problems, her suggestions also bear witness to her sympathy and wide experience in dealing with children. The eighty-four photographic illustrations depicting various children's activities add quite considerably to the human interest of the book, which is refreshing and reliable and may be recommended to any who are interested in the mental health of the new generation.

<sup>1</sup> "The Natural Development of the Child: A Guide for Parents, Teachers, Students and Others", by Agatha H. Bowley, Ph.D., with a foreword by D. R. MacCalman, M.D.; Second Edition; 1943. Edinburgh: E. and S. Livingstone. 7½" x 5", pp. 200, with illustrations. Price: 8s. 6d. net. Postage 5d.

# The Medical Journal of Australia

SATURDAY, MARCH 25, 1944.

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References to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Authors who are not accustomed to preparing drawings or photographic prints for reproduction are invited to seek the advice of the Editor.

## INDUSTRIAL MEDICINE AND THE FUTURE.

THE war has given a great impetus to the study of industrial medicine, and its advantages are patent to anyone with enough interest to look for them. During recent months industrial fatigue and absenteeism have been discussed in these pages, but they are only part of the larger subject. Though strides have been and are being made in industrial medicine, the gospel of industrial health has still to be preached. New adherents to the cause have to be won, the practice of industrial medicine has to be extended and health in industry must be recognized as inseparable from the health of the whole community. For this reason the paper by Dr. W. T. Nelson published in this issue and the discussion that followed its reading are commended to the attention of readers. At the same time it is appropriate that readers should be made aware of some of the opinions expressed at the first industrial health conference to be held in Great Britain. A report of this conference has been published and makes interesting reading.<sup>1</sup> A useful summary of the report will be found in the *International Labour Review* of October, 1943.

The conference was called under the auspices of the Factory and Welfare Department of the Ministry of Labour and National Service, and the Right Honourable Ernest Bevin, the Minister, occupied the chair during part of the proceedings. The purpose of the conference was "to emphasize the importance of industrial health and to elicit further suggestions for promoting it". The Minister, in his opening speech, elaborated these objects and insisted that life could not be divided into "pre-war", "war" and "post-war" periods. He maintained that the efforts to improve safety, health and hygiene in industry had been intensified and had come to earlier fruition because of the war, and that what had been done would have to be consolidated and developed after the war was over. Industrial health could not be treated as a subject apart—

anything done within its scope had to be a contribution to wider work for national health. In the same way Mr. Bevin insisted that the problems were not only those of the industrial worker alone, but concerned the whole nation and its future. But even beyond this any strength and vigour in mind and body that were made possible would be a contribution to a higher standard for humanity as a whole.

The indivisibility of the whole health problem was emphasized by more than one speaker. The Right Honourable Ernest Brown, Minister of Health, pointed out that though the various health services were separately organized and had separate responsibilities, the loose strands of particular services had to be brought together into a "simpler and more sensible pattern" that they might be seen as parts of a single purpose—the whole health of every citizen. What was wanted was a thorough personal health service which would become "an accepted and assumed part of the ordinary basis of community living". It was the Government's intention to secure this service. Mr. Brown admitted that there was a certain risk of over-regimenting health, a risk of reducing human values in an over-organized machine. But, he said: "To recognize that risk is to wish to prevent it. It will be, as it must be, a fundamental basis of our new service that it keeps and fosters the individual personal relationship of doctor and patient, and that it regards the family unit as the best background of health. Corporate responsibility, yes; bureaucracy, no." Mr. Brown pointed out that in 1942 there were in England some 700 doctors attached to factories and business organizations, and that about 150 of them had full-time appointments of this kind. He said that if in the future a full family medical service was provided in properly equipped group practice, it would surely be wise to encourage a state of affairs in which doctors so engaged could be brought more and more, part-time, into medical supervising and advising jobs in factories. This is a logical view and one to which many will readily subscribe, but the matter is not so simple as it sounds. The important point is that the family medical attendant shall have some accurate knowledge of the conditions under which his patients work. Dr. A. J. Amor, Deputy Chief Medical Officer of the Ministry of Supply, pointed out at a later stage in the conference that real knowledge of working conditions cannot easily be gained; a superficial knowledge, he implies, is useless and, we may add, perhaps dangerous. In the course of an address on team work in industrial medicine (we do not propose to deal with the main subject of his remarks) he said in regard to factory doctors:

It is not our job to spend all day in a beautiful surgery with chromium plated taps, carpets on the floors, graphs, indicators and charts all over the walls. We must get into the factory and, if you like, experience the anxieties of the girl who is making detonators. . . . Go and work at a battery of nitrators making T.N.T. and see how you like it day after day; accept the responsibilities of the people in the factories, and then when you come to discuss environment, fatigue and absenteeism, we shall be able to discuss them with a deep human knowledge based on something we have experienced within the factory. . . . Industrial medicine is preventive medicine, and can only be practised in the factory where the origin of many of the aches and pains may be discovered and steps taken to avoid them.

It is a little difficult to see how an intimate knowledge of factory work is to be gained by a part-time factory officer, but there can be no question of the truth of Dr. Amor's views in regard to full-time officers. A part-time officer

<sup>1</sup> Ministry of Labour and National Service, Conference on Industrial Health, Caxton Hall, Westminster, 9th, 10th and 11th April, 1943, Report of Proceedings; 1943. London: His Majesty's Stationery Office. 9½" x 6", pp. 107. Price: 1s. 6d. net.

might, of course, find time to investigate occasional problems in the factory as they arose.

Returning to Mr. Brown's remarks, we note that he was on safe ground when he suggested that when factories were large enough to need whole-time doctors, the family practitioner could keep in close touch with the factory doctor and learn from him something of working conditions. In these circumstances he would have to be guided by the opinions of the factory doctor. Mr. Brown observed that the work of approximately 1,700 examining surgeons was undertaken by general practitioners, and there will be agreement with his view that this link with the family doctor is sound.

Some forceful views were put forward by Dr. C. Hill, Chairman of the Central Council for Health Education and Deputy Secretary of the British Medical Association. In discussing the place of industrial health services within a comprehensive medical service, Dr. Hill referred to the enlightened impulse which the Treasury had stimulated among many employers regarding industrial medical services and did not think that it would endure after the war. Referring particularly to medical and nursing services in factories, he said quite bluntly that it was no use pretending that the service covered to any extent the sort of factory in which it was most needed. The majority of workers were employed in the smaller factories which were as a whole not covered by the factory health service. It was indeed roughly true to say that the factory health services predominated in the factories where by the nature of size and set-up they were least needed. Dr. Hill had two other important observations to make. One was that there should be no attempt to divorce factory environment from the general environment. The medical officer of health, Dr. Hill averred, had the right to enter factories only in relation to problems of the water closet and the fire escape. He suggested that unless and until the factory service became part of a national environmental service, with all that that meant, it would not earn the right of continuance as an essential part of the machinery of the country. Dr. Hill's other contention was that the factory health service was an employer's service, and that while the service remained an employer's service there were factors which militated against its efficiency. Sometimes workers thought that the doctor, being paid by the employer, was an employer's doctor. While he did not think that this was generally true, Dr. Hill did believe that in such a set-up there was a danger that men of the highest integrity might tend to adapt the advice they gave to what they knew its reception would be by those to whom the advice was given. With such a set-up this was an inevitable feature, and Dr. Hill had the temerity to remark that such a happening was sometimes seen in the public health service. Let us quote Dr. Hill's words:

In my view, while this remains an employer's service it will remain haphazard, incomplete and incapable of great development, and it will not cover that great section of industry where it is most needed. If it is a national obligation to see that the factory environment is as well-cared for as the non-factory environment, this service should not be left as a purely employer's service. This aspect from among those chosen by us for comment we have deliberately left till last because we believe it to be of fundamental importance. Attention has been drawn to it on previous occasions in these pages. At the present conference, the remarks of one speaker, Mr. Manning, a shop

steward, were particularly cogent in this regard. He described himself quite late in the conference as probably the first person to speak who was actually one of those around whom the discussion had centred—he was an industrial worker, an engineer who worked on a lathe. He said that it was a pity that he was in such a minority. If the aim was cooperation on the question of industrial health between the Government and the employers and the workers, then all the parties concerned should be present to discuss it. Mr. Manning also said he had been shocked to hear that the body responsible for the conference had been in existence for one hundred years and the conference was the first that had ever been held. Mr. Manning's observations make a suitable conclusion to our present discussion, for all attempts to make industrial medicine part and parcel of the general health service of the community will fail unless factory workers throughout the length and breadth of the country learn to appreciate its advantages and demand them as a right.

## Current Comment.

### DETACHMENT OF THE RETINA AND TRAUMA.

In the third edition of "Recent Advances in Ophthalmology", Duke-Elder has a long an interesting chapter on detachment of the retina in which he discusses the aetiology. He states at the outset that though it is not possible to speak authoritatively on the subject, it is quite certain that no one cause can explain all types of cases met with clinically. He divides retinal detachments into two main classes. The first is the exudative type which is essentially due to a general chronic vascular disturbance in the choroid, caused either by disease such as syphilis, tuberculosis, nephritis and so on, or by engorgement consequent on the presence of a neoplasm, venous thrombosis or similar condition. The second type is the non-exudative type which is essentially due to local inflammatory conditions in the choroid, degenerative changes such as those occurring in myopia and senility, or traumata. The immediate cause of such a detachment is, he states, the formation of a retinal hole. At the same time Duke-Elder insists that all detachments are by no means included in the two groups, although these, however, in all probability account for many of the cases sometimes called idiopathic. In regard to the part that may be played by trauma, Duke-Elder mentions detachment caused by gross trauma in a relatively healthy eye. "When no other weak spot exists, and if an injury is sufficiently severe, the retina gives way at the point where it is thinnest and where the vitreous framework has its fullest development and its firmest anchorage." J. C. Holst, writing in 1940,<sup>1</sup> concluded that perforating eye injuries could cause retinal detachment in healthy eyes, that direct blunt force could cause detachment in eyes not predisposed and that indirect trauma seldom caused detachment unless the eyes were myopic or had senile degeneration or were both senile and myopic. Holst based his remarks on a series of 283 cases of detachment in which 47 were most likely due to trauma. In 16 of the 47 cases there had been a head injury but no direct trauma to the eye. Eleven of the 16 patients were myopic and five were emmetropic. Holst holds that head trauma *per se* will not cause retinal detachment in the normal eye and he points out that boxers rarely develop detachment unless struck directly on the eye.

Arnold Knapp holds that the relationship of retinal detachment to trauma must remain vague.<sup>2</sup> He told the American Ophthalmological Society last June that one cannot but be struck by how generally the thesis of a

<sup>1</sup> *Acta ophthalmologica*, Volume XVIII, 1940, page 190; quoted in "The 1942 Year Book of the Eye, Ear, Nose and Throat", page 192.

<sup>2</sup> *Archives of Ophthalmology*, December, 1943.

traumatic origin is accepted. He has reviewed 400 cases in which he has had the opportunity of making an examination. In the 400 cases the following associated conditions were present: myopia, 202 cases; trauma, 52 cases; hæmorrhage (vitreous and retinal), 21 cases; aphakia, 37 cases. Detachment was bilateral in 58 cases. The degree of myopia was over ten diopters in 25% of cases, from five to ten diopters in 42% and up to five diopters in 33% of cases. The danger of detachment gradually increased with the degree of myopia up to a certain point and was greatest between eight to sixteen diopters of myopia. Detachment occurred with greatest frequency in persons between forty-five and sixty years of age; and Knapp remarks that this is the age when nutritional disturbances occur in the ocular tissues. The incidence decreased as the degree of myopia increased; direct injury was more frequent in cases of hypermetropia than was indirect injury; and spontaneous detachment was the rule in cases of myopia. Knapp divides cases of traumatic detachment into those which occur in previously healthy eyes, and those which occur in previously defective eyes; he classifies the traumata as direct and indirect. Direct trauma (responsible in 32 of Knapp's 52 cases) generally resulted from direct blows to the eyeball; it occurred chiefly in the cases of young persons and myopic eyes did not predominate among them. Indirect trauma was caused by severe blows to the head or body, succussion of the head or body, excessive bodily exertion such as that in lifting, and excessive coughing and sneezing. Knapp points out that to explain the relation between retinal detachment and indirect trauma a predisposition on the part of the eye is assumed, "and it is believed that in the presence of certain changes in the eye (predisposition), a mild injury or sudden circulatory disturbance on muscular exertion may be the determining cause of a detachment which is ready to develop, just as the detachment generally occurs without trauma". In Knapp's 20 cases associated with indirect trauma the patient's age was generally above forty years; myopia was present in fifteen cases and hypermetropia in four. Knapp points out that the predisposition mentioned by him consists in certain changes in the eye which are present in myopic eyes and make them susceptible to retinal detachment. He discusses these shortly and makes the reasonable statement that if the same histological changes explain the onset of spontaneous and of traumatic detachment, it is impossible to draw a sharp distinction between the two types. If movements of the vitreous are accepted as a factor in the causation of spontaneous detachment, they can, Knapp thinks, all the more explain the mysterious detachment after an indirect trauma. And Lindner has shown that it is not just the shaking of the eyeball that produces a detachment, but that the force must be a rotating or whirling force. It would be possible to extend the discussion much further along these lines and to refer to cases mentioned by Knapp and others showing that movements of the vitreous, the pull of the external eye muscles and traction on the optic nerve have been held to be at least partly responsible for a detachment; but mere reference to them must suffice. Two special aspects referred to by Knapp should be mentioned. One is the bilaterality of retinal detachment and its frequent association with myopia, which do not point to a traumatic origin. The other is the association of detachment with aphakia; here Knapp thinks that retinal detachment is related to trauma only in its widest sense. Unfortunately the significance of the hole that is present in some cases of detachment must be passed by; readers will find a good discussion on that aspect in Duke-Elder's "Recent Advances in Ophthalmology".

Knapp concludes that though the cause of detachment after indirect trauma is difficult to define, the question of the relationship cannot be dismissed as irrelevant. He reminds us that all persons are inclined to find the cause for an accident, especially if compensation is a factor. "A guiding rule in the estimation of the cause would be that the exertion must be greater than usual and that the symptoms of detachment should promptly follow." The whole question of trauma and changes in the retina,

chorioid, vitreous and so on is one to which more attention should be paid. Though the suggestion may be regarded as academic, it would be interesting to inquire whether trauma might not be responsible for some of the conditions which create the predisposition on which indirect trauma may act later on. A. J. Bedell has published a paper on traumatic changes in the retina, chorioid, nerve head and vitreous that has a bearing on this point.<sup>1</sup> He mentions *inter alia* retino-chorioiditis as being caused by trauma.

A final point must be mentioned. In a footnote to a reference to retinal detachment and accident, L. Bothman<sup>2</sup> states that he has learned that "a large number" of retinal detachments occur in parachute jumpers. A full investigation of these cases might help to elucidate the whole subject.

#### FROM THE PATIENT'S POINT OF VIEW.

ALL who have access to *The Lancet* cannot fail to be grateful to the genius who first suggested the publication of the "In England Now" column and to many of the "peripatetic correspondents" who have contributed to it. Here, shrewd observation, humour, common sense, a leaning to the ridiculous and unusual jostle one another and either point a moral or make one say: "Of course, it would happen like that", or: "What an idea", or: "The fellow is a hard case and no mistake". In a recent issue<sup>3</sup> one of the "peripatetics" remarks that it would be good for all of us if we could change places with our patient an hour before he is due to go to the theatre for his operation. He then gives "something of the atmosphere" as it was described by a patient after appendicectomy. The reader may be forgiven if he has a strong suspicion that the patient was none other than the peripatetic himself. In any case the description makes good reading and will be appreciated by any doctors who have been cast in the role of patient in an operating theatre, even if they have not breathed the whole "atmosphere" created by the peripatetic. The whole procession of events is set out—the patient waiting and not feeling too brave; the jabs of the nurse with the blunt hypodermic needle; the chart left lying while the nurse is called away and showing a high temperature; a feeling of sleepiness with the loud and louder voice of the nurse; the blinds not drawn; the trolley and the journey to the theatre with the bumps on the door and the squeaks of the unrolled castors and the meeting with poor old Smith who has just been operated on and is glimpsed looking more like a corpse on his trolley than anything else; the smell of the anæsthetic in the annexe; the booming voice of the anæsthetist: "Well, old man, you should be asleep by now"; "I wish the nurse would hold my hand"; "the doctor is telling the nurse about the chap in the bed next to me . . . I am sorry poor old Smith is a gonner . . . hope I won't be in the same boat".

There is much in the peripatetic's description, quite imperfectly outlined here, on which serious discussion might be based. *The Lancet* itself has an editorial on "Comfort in Anæsthesia" in which reference is made to the peripatetic's story. We do not intend to do more than remind doctors that the patient is the chief actor in the drama of illness, if such it can be called. Familiarity with operative or other procedures easily creates a lessened appreciation of the patient's susceptibilities and sufferings. There is need for a constant overhauling of methods and an analysis of details. Some day (who knows?) a hospital board may, in advertising for medical officers, declare that preference will be given to those who have themselves undergone an abdominal section, or had an attack of pneumonia, or suffered from a compound fracture, or given birth to twins. There would be reason in such a demand and peripatetic correspondents would not be the only persons to approve.

<sup>1</sup> *The Journal of the American Medical Association*, Volume CXVII, 1941, page 1774.

<sup>2</sup> *The 1942 Year Book of the Eye, Ear, Nose and Throat*, page 282.

<sup>3</sup> *The Lancet*, December 11, 1943.

## Abstracts from Medical Literature.

### SURGERY.

#### Medical Treatment of Haematogenous Osteomyelitis.

D. E. ROBERTSON (*Annals of Surgery*, August, 1943) presents a series of 89 cases of acute osteomyelitis treated with sulphonamide drugs. Acute osteomyelitis is a disease mainly of childhood and adolescence caused usually by streptococci or staphylococci, the latter being the causal organism in 90% of cases. The bone lesion is an incident in a generalized infection. In recent years the place of early operation in the treatment of the condition has in the opinion of the author been unduly stressed. He considers that the advent of the sulphonamide drugs may lead to a revision of the treatment. Prior to using these drugs, the author found the mortality from this disease to be about 22%. No records are available of the mortality among patients who did not have surgical treatment at all. But the author suggests that such cases would probably have a much lower mortality than 20%. Natural resistance to the disease involves first the formation of antitoxin which may protect the body against the toxin formed by the organism, but will not destroy the organism itself. If the antitoxin formation is adequate, the body can then produce other substances which will have a direct action on the bacteria. The sulphonamide drugs in adequate concentration can, however, inhibit the growth of organisms in the blood stream or within reach of the body fluids. Furthermore, the administration of the drug does not interfere with the natural production of antitoxic substances. The drug should be given early in large doses so as to attack the organisms before they become drug-resistant. Sulphathiazole is the drug which has been used in this series, and it has been given in dosage to maintain a blood concentration of 6 to 12 milligrammes per centum. A few patients had reactions to the drug, mainly high fever or rashes. In these cases, the drug was suspended, and administration later started, sulphadiazine being given. This drug appeared to be rather better tolerated, and higher blood concentrations could be maintained with it. It is suggested that sulphadiazine may be the drug of choice for these patients. All the 89 patients in this series received sulphonamide therapy. Of these, 25 had no operative treatment, and all recovered. Three patients were moribund on admission to hospital, and died within some hours of admission. Of the remaining 61, all of whom had late incisions of abscesses, 60 recovered and only one died. Under the medical treatment, abscesses may disappear completely, or may come to the surface and need late opening. In any case, sequestration of bone remains at a minimum, being seen in only 10% to 15% of cases, compared with more than 50% in cases in which early operation has been performed. Involucrum formation is correspondingly slight. In the cases which subside without operation, the body appears to be able to

deal with the small fragile sequestra which probably form. Obvious death of a large mass of bone is rare, as is also the occurrence of secondary lesions in other bones. When these do form, they run an attenuated and non-virulent course. The author stresses the need for adequate drug therapy at the earliest possible moment. The diagnosis must be made early by consideration of the history (a skin lesion is almost always responsible), by the general reaction of an acute infection, and by the local findings in the affected bone. The author concludes that incisional interference in the early stages is not a factor in saving lives, and may be a very harmful proceeding.

#### Burns of the Extremities.

S. M. LEVENSON AND C. C. LUND (*The Journal of the American Medical Association*, October 2, 1943) report their experiences with the use of close-fitting plaster casts in the treatment of burns of the limbs. Glenn, Peterson, Gilbert and Drinker have recently indicated the harm which results from the swelling associated with burned tissues. They also showed that application of a close-fitting plaster cast immediately after the burn, prevented swelling, while leaving the circulation unimpaired. Where swelling was allowed to occur, this factor itself resulted in impaired capillary flow. The principles followed by the authors are that no anesthetic is given, and no débridement is performed except for the removal of large pieces of loose hanging skin; the whole area to be encased in plaster is covered with a layer of sterile "Vaseline" gauze, each finger being treated individually in this respect; this layer is covered by four layers of open mesh dry gauze, fitting without overlapping, and not passing between the individual fingers; the light plaster is carefully moulded on and extends a few inches above the upper limit of the burn, and includes the whole of the distal part of the limb, the end being closed beyond the fingers which are placed in the position of rest. The treatment should begin at the earliest possible moment, before swelling has started. Chemotherapy may be necessary in some cases. The cast is left on for fourteen days, then removed, and if healing is not complete it is renewed at once for another fourteen days. After this time further treatment, if required, is by other methods. The authors claim for the method that it avoids the danger of absorption of tannic or picric acids with possible liver damage. The possibility of increasing the local damage to tissues by tanning is absent. The treatment is comfortable and easy to apply. Toxic absorption is kept at a minimum by the immobilization, as shown by Barnes and Trueta. No time is wasted in frequent dressings. Transport is facilitated, and excellent functional results have been obtained.

#### Stricture of the Rectum.

L. G. BODKIN (*The American Journal of Surgery*, August, 1943) discusses the causation of symptoms in stricture of the rectum, and suggests a new form of treatment. The commonest benign cause of the condition is *lymphopathia venereum*, but it may follow any extensive mechanical, chemical or bacterial injury to the rectal mucosa.

The outstanding symptoms are constipation, tenesmus and mucopurulent discharge. The course of the disease usually comprises a long series of dilatations or operations, followed each time by recurrence, and often ending in colostomy. In analysing the stories given by patients, the author noted the frequent occurrence of a statement that they had great straining with little result, and that finally, when the straining ceased, a liquid or semi-solid stool passed. It appeared that such a stool should have passed without difficulty through the constricted lumen. The author suggests that the cause of the difficulty is that the rectal wall above the stricture prolapses into the narrowed portion, so plugging it during the process of straining. When the straining ceases, the prolapsing mucosa recedes, and the motion is passed. It therefore seemed reasonable to expect that relief might be afforded to these patients by neglecting the stricture itself and concentrating on fixing the rectum above the stricture in order to prevent its descent into the stricture. The method used was to enter the post-rectal space through an incision between the anus and coccyx, and by blunt dissection with the finger, to separate the rectum from the surrounding structures up as far as the level of the peritoneal floor of the pelvis. This space was then packed posteriorly and on either side with three gauze packs which were removed at daily intervals over the three days after operation. Dilatation of the stricture or incision of its outer aspect may be performed at the time of operation, but it is doubtful if any good is likely to result from this, as contracture will again occur. Post-operative dilatation is not recommended. The stool itself which now passes more freely is allowed to act as a dilator. Cases are reported in which the author has performed this operation and results appear to indicate considerable relief of symptoms. Proctoscopic examination showed that the lateral and posterior walls of the rectum did not tend to prolapse into the stricture on straining, though the anterior wall did show a slight tendency to do so, but not enough to occlude the lumen.

#### Carcinoid Tumours of the Ileum.

M. B. DOCKERTY AND F. S. ASHBURN (*Archives of Surgery*, September, 1943) were able to study at the Mayo Clinic pathological material from some 130 cases of tumour of the small intestine. Among them thirty cases of carcinoid tumour of the small intestine were found, and of these thirteen were selected for study because of the undoubted presence of metastases. The present communication comprises a general discussion of carcinoids of the small bowel with a detailed discussion of the thirteen selected cases. In the whole series, carcinoid tumours represented 23% of all malignant neoplasms of the small bowel. The condition is considerably more common in the appendix, and reports by other authors from the Mayo Clinic placed its incidence in that clinic as 0.47% of all surgically removed appendices. The average age of patients in the thirteen cases was 58 years. Nine patients had symptoms of "disturbed intestinal function" for an average period of 42 months. Usually complaint was made of recurrent attacks of crampy

abdominal pain, sometimes related to meals and relieved by regurgitation. The symptoms were generally milder than those associated with the ordinary type of adenocarcinoma of the ileum. The passage of blood, commonly seen in the latter condition, appeared only once in this series, and was then attributed to hemorrhoids. Constipation was present in some cases, and diarrhoea in others. In only three cases was the tumour "silent" in regard to gastro-intestinal symptoms. A common finding is that multiple primary foci of carcinoid tissue occur, and in one of this series, 68 independent primary foci were found in the ileum. The primary tumours tend to be small, and are frequently exceeded in size by the secondary deposits. Mucosal ulceration over the tumours is not a marked feature, though microscopic examination will usually demonstrate its presence. Peritoneal spread may lead to puckering and acute kinking of the bowel, and this may prove useful in radiological diagnosis. Secondary deposits were found in the mesenteric lymph nodes and in the liver. It has been contended that certain carcinoid tumours are benign and others malignant. The authors think that all carcinoids are malignant neoplasms arising from glandular epithelium, and therefore carcinomata in every sense of the word. So-called benign and malignant examples are identical histologically. Histological features indicate, however, a low grade of malignancy. Treatment should consist of as radical a procedure as circumstances allow. This should be carried out even in the presence of metastases in the liver, as removal of the primary growth may be followed by the secondary growths becoming "stationary". Among the present series of thirteen cases, eight patients are alive and "surprisingly well" at periods varying from ten months to nineteen years since the operation.

#### Tetanus Treated by Curare.

S. C. CULLEN AND C. S. QUINN (*Surgery*, August, 1943) report the use of curare in a case of tetanus. They point out that while the control of spasms by heavy sedation has proved beneficial, there are numerous disadvantages, such as the danger of pulmonary complications and the difficulty of maintaining adequate nutrition as a result of the patient's inability to eat and drink. Curare was used in the hope of securing relaxation without depression. The patient, a man of forty-eight, had sustained a wound of a finger of the right hand five weeks before admission to hospital, and had commenced to exhibit symptoms of tetanus for one week before admission. Soon after admission an opisthotonic spasm occurred, and these spasms recurred every few hours. Tetanus antitoxin was administered, 20,000 units being given by intramuscular injection, and 30,000 units into a vein, on the night of admission. Another 50,000 units were given by intravenous injection the following day. The small local lesion was opened, excised and dressed with zinc peroxide paste. For the first forty-eight hours the patient was given "Avertin" *per rectum*, the relaxation or otherwise of the abdominal wall being used as a guide to dosage. In spite of marked general and respiratory depression the spasms

continued, the onset of pneumonia was apparent, and was later verified radiographically. The use of "Avertin" was discontinued, and the administration of curare was begun, in the form of "Intocostin". This is ineffective by mouth or by subcutaneous injection, and was given intramuscularly or intravenously, both routes seeming to be equally effective, the latter producing a more rapid action. After the "Avertin" depression had disappeared, the curare effect was spectacular, and at the height of a spasm an intravenous injection of the drug produced relief in a few seconds. As with "Avertin", the frequency of curare administration was determined by the tone of the *rectus abdominis* muscle. By the seventh day the supply of curare was exhausted, and treatment was continued with  $\beta$ -erythroidine, a drug similar in action. This produced approximately the same effect as curare, but was associated with faintness and a fall in blood pressure, which had not occurred with curare. After the ninth day the spasms were no longer severe enough even to cause the patient discomfort, and he was put back on mild sedation by phenobarbital. The patient was discharged from hospital on the eighteenth day.

#### The Use of Curare in Improving Muscle Relaxation during Anaesthesia.

S. C. CULLEN (*Surgery*, August, 1943) reports his experiences with curare in 131 cases of inhalation anaesthesia. The drug was given in order to assist in obtaining relaxation of the abdominal muscles. In most cases cyclopropane was the anaesthetic agent, and the investigation aimed at securing satisfactory muscle relaxation with the advantages of a non-irritating gaseous anaesthetic agent. The results were considered to be satisfactory, and the patients awoke rapidly after operation and required minimal immediate post-anaesthetic care. Premedication with scopolamine and morphine was carried out. Some transient respiratory paralysis was noted, but was readily controlled by rhythmic compression of the bag on the anaesthetic machine. One death occurred, but the patient is described as being moribund before operation, which was undertaken for wound dehiscence. It is explained in a footnote that since submitting the article for publication the author has had experience with the use of the drug in a further 370 cases, and the results continue to be quite satisfactory.

#### Hypertension and Sympathectomy.

J. D. ADAMSON AND SARA DUBO (*The Canadian Medical Association Journal*, September, 1943) report their observations of the effect of surgical operations on blood pressure. The blood pressures of 208 patients before and after major operations, and of 28 additional patients with hypertension who were not operated on, were followed while the patients were in hospital. A reduction of blood pressure in all patients was found, and was similar in the operative and non-operative groups. The reduction was much greater in actual millimetres of mercury and in percentage among those with high blood pressure. The actual reduction and percentage reduction in

systolic and diastolic pressure was comparable to what is usually stated as being due to specific operations on the sympathetic nervous system. It was found that subjective symptoms had a tendency to disappear during a patient's stay in hospital whether or not operation was performed. The authors claim that alleged specific effects must be measured against known non-specific effects which take place concurrently with all surgical operations.

#### Intractable Pruritus Ani.

F. YOUNG AND W. J. M. SCOTT (*Surgery*, June, 1943) regard *pruritus ani* as a symptom complex rather than as a separate disease. Many causes may give rise to this symptom, but the exciting cause in many of them is the fact that the peri-anal skin is constantly moist. In spite of all the usual methods of treatment, the condition in some patients will prove intractable. For these, the authors suggest a new operation. The method is to excise the affected area of skin with the thickened subcutaneous tissues, a start being made at the mucocutaneous junction and the surgeon working laterally until normal tissues are reached. This is done on one side of the anal canal at first. The bare area so left is covered by a graft of skin and subcutaneous tissue raised from the buttock and thigh on that side, with a pedicle posteriorly. This graft is swung over and sutured accurately at the anal margin. The area left uncovered laterally is then closed as far as possible, tension being avoided. The portion of the bare area which cannot be closed is left to heal by granulation. A small rubber drain is left under the base of the flap, and a snug perineal binder applied. The operation is repeated on the other side in from two to three months. The authors report successes with this method.

#### Acute Gastro-Duodenal Perforations.

E. J. MCCABE AND W. L. MERSHEIMER (*The American Journal of Surgery*, October, 1943) present a review of eighty-nine cases of perforated peptic ulcers in patients admitted to the Metropolitan Hospital, New York, from 1930 to 1941. Ten of the perforations occurred during treatment in hospital. The authors consider that a radiographic examination for subdiaphragmatic gas should always be made, and that in doubtful cases the injection of 20 to 30 cubic centimetres of air through a stomach tube may help to establish the presence of subdiaphragmatic gas. The authors consider that it is imperative that a specimen of blood be withdrawn and an estimation of blood amylase be made to exclude pancreatitis. When the results of both radiograph and amylase estimations are normal, it is recommended that peritoneal tap and aspiration be performed preferably after the intragastric administration of a dilute solution of methylene blue, recovery of which by paracentesis is diagnostic of a ruptured viscus. In the authors' series the average interval between admission and operation was over two and a half hours. Conservative operative measures were followed. The gross mortality in the series reviewed was 25.2%.

## British Medical Association News.

### SCIENTIFIC.

A MEETING of the New South Wales Branch of the British Medical Association was held on November 25, 1943, at the Robert H. Todd Assembly Hall, British Medical Association House, 135, Macquarie Street, Sydney. Dr. K. S. M. BROWN, the President, in the chair.

#### Industrial Medicine.

Dr. W. T. NELSON read a paper entitled "Industrial Medicine" (see page 269).

Dr. M. R. FINLAYSON said that it was a long time since the subject had been brought up for discussion at a Branch meeting; he hoped that it meant that the subject would now take the position of importance it must occupy in the near future. The provision of adequate facilities for industrial hygiene was of the greatest importance, and with the large increase of industrialization and the introduction into industry of a great number of untrained people, the regulations had to be very carefully supervised. Dr. Finlayson agreed with Dr. Nelson that the subject had not received sufficient serious attention in the past. The fact that there was no division of hygiene in the Commonwealth Government was a bad start, and he hoped to see the development in that direction that they had hoped for in the days of Dr. D. G. Robertson. Dr. Finlayson said that Dr. Charles Badham had done a tremendous amount of good work, and he was greatly missed; but it was to be hoped that the State of New South Wales would rapidly enlarge its activities in that sphere. Dr. Finlayson thought that anything that was done in the future should be bound up with any scheme for the nationalization of medicine brought forward in Australia. He stressed the importance of rehabilitation of the injured worker. This was brought into the foreground by the return from the services of a number of workers in a subnormal physical condition. At present the man who had a long term disability had a poor spin. He was not wanted by the busy general practitioner, who had no time to follow up all the small details that were necessary for the best functional result; the hospitals did not want him, because he was a "compensation case". That was why in injury cases a special hospital was necessary. Dr. Finlayson thought that it was not a remote idea that the New South Wales Government Railways should establish such a hospital, in view of the 52,000 workers for whom the department was responsible; the hospital would be a large one, in the city, and there injured workers could be controlled and treated by a specially trained staff and with the services of specialists in all branches. Another point was the question of research in industrial medicine; Dr. Finlayson held that there was great scope for that. One subject for such investigation was the relationship of dermatitis to industry; it was a big problem at the present time, not only in Australia. In America dermatitis had taken its place at the head of the list of incapacitating diseases. Many elementary precautions in industry were not even thought of in many present-day factories. In the older established factories, even adequate supplies of hot water were not provided. The controllers of industry must realize that the days when the worker was allowed to work amid dust and dirt and without any convenience were gone. The worker must have all facilities to protect his health. Until a few years ago some of the demands of workers were thought fantastic; but now the things demanded were regarded as necessities. Dr. Finlayson then referred to the question of the "first-aid man", of which Dr. Nelson had spoken. At the present time, in many factories men were appointed to first-aid posts who knew little about asepsis. Dr. Finlayson believed that unless a man had had some hospital training he made a poor first-aid man. Where possible, trained nurses should be employed in large industrial concerns. In conclusion, Dr. Finlayson said that he was glad to have the opportunity of supporting Dr. Nelson's plea for greater interest in the subject of industrial hygiene.

Dr. H. L. KESTEVEN also supported Dr. Nelson's plea for greater interest in the subject. Unlike Dr. Nelson and Dr. Finlayson, he had been inside the factory and had lived with the men for years. One point he wished particularly to stress was the fact that industrial medicine paid; it was actually a dollar-saver when it was properly carried out. Dr. Kesteven knew places in the United States of America where a medical man was paid the equivalent of about

\$1,000 per annum with bonuses on what he saved the concern. One factory in Sydney, acting on Dr. Kesteven's advice, spent £3,000 in installing hot-water showers; in less than twelve months they had paid for themselves and proved a good investment. Dr. Kesteven said that industrial medicine was the acme of preventive medicine. Some years previously he had spent much time in trying to ascertain the average time lost through sickness by metropolitan populations. The figures he had studied were extensive, and covered the United States of America, Germany, Denmark, England and Scotland. His researches led him to the conclusion that the amount of time lost was 9.9% of the total working time. Dr. Kesteven had fairly recently been able to give advice that brought about the reduction, within four months, of the time lost at a small arms factory in New South Wales from 15.5% to 1.5%. He pointed out the saving and help that such a reduction would mean to the management. It was essential that the industrial surgeon in charge of a factory should develop the attitude of regarding his men and staff as productive machines. They could be kept at high working capacity only if their happiness and health were thought of. As Dr. Nelson had said, the factory medical officer had to be a member of the factory team; he must sit on the councils and know all that went on. Dr. Kesteven then went on to refer to trichlorethylene; he pointed out that it was easily oxidized and immediately converted into phosgene. In the presence of trichlorethylene, therefore, smoking must be absolutely forbidden. Trichlorethylene itself was a dangerous substance. With regard to oil dermatitis, Dr. Kesteven said that a better preventive measure than scrubbing was pinch massage with warm water and soap; it was very effective.

Professor W. S. DAWSON said that he had found at the meeting plenty to interest the psychiatrist, and he congratulated Dr. Nelson on the broad view he had taken of the subject. Professor Dawson thought that many industrial problems would not be solved until there was an improvement in human relationships. These problems were not for the psychiatrist alone; they involved the most elementary general hygiene, and could be dealt with very well on the lines adopted by the regimental medical officer; they involved such measures as the inspection of the worker and his conditions, canteens, sanitary annexes *et cetera*. Training in the fitting and use of protective masks would also be included. If a good standard of cleanliness was provided, and if interest was displayed in the worker, much could be done to make him efficient. On the question of welfare, Professor Dawson also suggested that nurses and medical officers might have some general instruction of an elementary nature on the subject of temperament and personality, which would assist them in dealing with workers and their difficulties. Teams would have to be instituted, including properly trained social and welfare workers, which would be attached to the larger factories or would be available in certain districts. Professor Dawson said that the psychologists should also be remembered in connexion with the question of vocational selection. With their army experience they were being very well trained and sensitive to matters of temperament. They were reaching a degree of skill that was lacking in some general practitioners who had not turned their minds in those directions. By such means, and if the worker was shown that a personal interest was being displayed in him in addition to the attention paid to specific risks and hazards, a great deal of industrial unrest would be diminished and perhaps abolished.

Dr. W. L. CALOV also thanked Dr. Nelson for his paper. He said that he was rather disappointed that Dr. Nelson had not said more about cardiac disease and cardiac disasters. Dr. Calov had been interested in Dr. Nelson's remarks about cadmium. Dr. Calov had recently examined a man who was engaged in an operation known as mellozing, in which either molten metal or thin pieces of wire were put into a gun, which sprayed out fine particles to cover surfaces that had to be "painted". Cadmium was one of the substances used. The patient had said that the men were provided with masks, which it was impossible for them to wear; if they did try to wear them, the masks fitted badly, and as much of the substance penetrated underneath as if the men had no masks on. Dr. Nelson had said that it was not often that a satisfactory mask was found. Men had told Dr. Calov that in many instances it was impossible for them to wear with any degree of comfort the masks provided, and even if they did, they were no better off.

Dr. F. S. HANSMAN said that Dr. Nelson had covered a wide field. In the few factories he had had to enter, Dr. Hansman had been struck by the large number of minor points that the management seemed to neglect, attention to which would effect great improvement in the welfare of

the men. Dr. Hansman instanced a factory in which wire-workers were employed in air, the temperature of which was about 100° F.; an air-cooling device had been installed, but owing to the fact that it took in air from near the ceiling and not from low down, it sprayed the men with air 5° or 6° F. hotter than that in which they were working. The men were using up from 4,000 to 5,000 Calories per day; some of them lifted 10 to 18 tons per shift. Their diets were extraordinary, apparently consisting in the main of little but carbohydrate and meat, with no fruit and vegetables. It was certain that their vitamin content must have been considerably below the optimal figure. Moreover, they took insufficient salt and minerals to replace what they must have been losing by sweating. Another point which Dr. Hansman noticed was the absence of attention to the men's teeth; yet anything up to 6% of them had no chewing apparatus at all. Dr. Hansman pointed out that these workers were human beings, and as Dr. Kesteven had implied, a great deal more attention was paid to the welfare of the machines than to that of the men who worked them. Dr. Hansman thought that if only the controllers of industry realized the position, they would change their attitude, even though men were cheaper to replace than machines. The factory to which he had referred was in an orange-growing district, and oranges were to be had in plenty; why had no attempt been made to arrange for waste oranges to be obtained for the men? An improvement in the lot of the working man could be brought about easily. The industrial medical officer should have a higher status, so that he could gain the confidence of the management and (which was more important) of the men.

Dr. C. E. WINSTON said that Dr. Nelson's had been a stimulating paper. Dr. Winston hoped that the meeting might be the starting point of some new development in Sydney at least. Much was heard about the "new order" and "positive health". If there was ever a place for "positive health", it was in the field of industrial medicine. The stimulus necessary to reinvigorate industrial medicine would not come from industry alone; the controllers of industry would have to be shown that it paid to preserve the health of the workers. Dr. Winston agreed with Dr. Finlayson's remarks about the need for a special hospital for the treatment of industrial injuries and diseases. Such a hospital would perhaps not meet with approval by some general practitioners, but Dr. Winston, after much experience, thought that workers would be able to return earlier to their employment and with less permanent disability if they were treated in a special hospital with special appliances by practitioners with special knowledge. It was a shame that in Sydney, a city of one million inhabitants, there was not a single rehabilitation centre for any type of injury. The injured workers were taken a certain distance along the road to recovery by somebody, and then they were dropped and became a charge on the general public. Psychologically, they were damned; they felt that nobody cared about them.

Dr. Kesteven spoke again, on the subject of rehabilitation. He said that when a medical man was in the factory, the factory itself became the best rehabilitation centre. There was nothing that worked so well as industrial therapeutics. Whatever the injury from which the worker was recovering, a job could be found for him that would help in his rehabilitation.

Dr. E. A. STORMON said that he also had appreciated Dr. Nelson's paper, which he had found comprehensive. Dr. Stormon said that he himself had spent nearly all his professional life in industrial medicine, and he endorsed Dr. Nelson's remarks regarding teamwork. The general practitioner of the day was a very busy man; and Dr. Stormon found that teamwork with a number of doctors and trained assistants who had facilities for consultation, X-ray work *et cetera* and the services of a skilled masseur, reduced greatly the period of incapacity of the industrial worker. Dr. Stormon agreed with what Dr. Finlayson and Dr. Winston had said about the need for an industrial hospital for the treatment of injured workers. On the subject of oil dermatitis, Dr. Stormon said that a well-known dermatologist of his acquaintance refused to concede the existence of such a condition, or oil folliculitis, as it was more correctly termed, affecting the forearms. The condition in his opinion was oil acne, and it always affected the anterior portions of the thigh, owing not to the fact that the oil itself was the primary trouble, but to the fact that the clothes became soaked with oil and dirty and greasy, and the resultant friction did the damage. In a number of factories at the present time the men were made to work in shorts, and oil acne had been abolished from them. The question, of course, was one of hygiene and cleanliness.

Dr. K. S. M. BROWN said that his knowledge of industrial medicine was not extensive, but he had gained a few ideas about it. He had been for some time connected with an American firm, and this connexion had led him to believe that Australia had a great deal to learn about the management of industrial concerns. The factory was small, and to him seemed rather ideal. It was well built, the ventilation was good, the inside of the factory was bright, the surroundings were attractive with trees and lawns, tennis courts *et cetera*. The washing rooms were pleasant, and hot and cold water and showers were available. There was a canteen, and an efficient personnel officer was employed. Dr. Brown's impression was that the factory was well run, and that the morale of the workers was high. When it opened, he was detailed to make a thorough physical examination of the employees. The employees were worried and had palpitating hearts, because they thought, as he did, that the examination was being made to determine their suitability for employment, and they feared that they might not be taken on. However, it was found that the examination was entirely for the benefit of the workers. The personnel officer took a kindly interest in each workman and his family affairs. Dr. Brown thought that a great deal of misunderstanding would be cleared away if the personnel officers in other factories would take more interest in the workers. If, for example, they received a medical certificate that was not satisfactory, they should telephone to the doctor and discuss it with him. It was impossible for the doctor to know all the circumstances surrounding an application for a certificate about absence from employment. The blame for unsatisfactory certificates was not wholly his; much of it lay at the door of the lack of understanding in Australia as to how such factories should be run. Dr. Brown had with another doctor made an inspection of other factories in his area, and they had been horrified at the difference between the conditions in these and those obtaining in the factory to which he had referred earlier. The matter was not only one for the medical profession; a large part of the responsibility lay with the employer or the Government.

Dr. Nelson, in reply to Dr. Kesteven, said that he had been very interested to learn of the mathematical approach to the question of the cost of industrial medical services and the savings that were brought about by the scientific management of industrial problems. Pinch massage in the prophylaxis of oil dermatitis was new to him, and he intended to try it. His experience with the condition had been gained in munition factories, where they had got rid of it in the manner which he had described. Dr. Nelson thanked Professor Dawson for his remarks; he had been interested to hear him differentiate between the psychiatrist and the psychologist. Dr. Nelson differed from Professor Dawson on the question of the use of lay psychologists; Dr. Nelson thought that medical men were far more use to industry in deciding what vocation should fall to the lot of any particular person. The medical man had a much better appreciation of the physical handicaps, various eyesight deficiencies *et cetera* and the general make-up of the applicant. Medical men rather than lay psychologists should do this work. Dr. Nelson thought that in Australia there was too much non-medical interference with medical matters; at least, that could be said of Sydney. Dr. Nelson agreed with Dr. Calov's remarks about masks. At the present time there was a great shortage of supplies from America. The making of masks was a developed technical science in America. Australian difficulties were due to the fact that there was a poor supply of masks and no advisory body for masks. Dr. Nelson had been interested in Dr. Hansman's remarks about the use of fruit and vegetables in diet, and on the lack of salt. Dr. Nelson heard from men returning from the war that salt was considered very important in their diet, particularly in the tropics, and that heat exhaustion was largely obviated by the ingestion of plenty of salt. With regard to the teeth of the workers, Dr. Nelson said that when he was in Kalgoorlie he investigated the condition of the teeth, the presence of pyorrhea *et cetera*. The incidence of dental defect was very high. Dr. Nelson also said that he had been greatly impressed by Dr. Hansman's sympathetic outlook with regard to workers in factories. There was much to be learnt in Australia with regard to the attitude that should be adopted towards workmen. At the present time industry was experiencing many difficulties with regard to the workers, and the causes were deep-seated. Dr. Nelson stressed the fact that a more sympathetic outlook was necessary, and pointed out that doctors had the essential appreciation of a man's difficulties, psychological and physical. Dr. Nelson had been interested in Dr. Winston's remarks about industrial hospitals. He drew Dr. Winston's attention to the fact that under the

provisions of the *Workers' Compensation Act* the money was available for rehabilitation. Possibly the insurance companies would be interested. Dr. Nelson then referred to Dr. Stormon's remarks; Dr. Stormon, he knew, worked in a happy atmosphere with good teamwork. Dr. Nelson had been amused to hear a denial of the existence of oil dermatitis. The occurrence of acne on the thighs was well known. Dr. Nelson simply called it oil dermatitis, and did not even bother calling it folliculitis. Dr. Nelson then referred to Dr. Brown's remarks about the personnel officer who carried out his investigations even into the private lives of the workers. Dr. Nelson had recently been in another city and had discussed the matter with the heads of several large manufacturing plants. They were opposed to preemployment medical examination, because of the hostility of the trades unions. With regard to the welfare of the workers outside the factories, they were strongly opposed to any such activities on the part of the personnel officers, and they had adduced good reasons for their attitude. Not everybody was in agreement with the principles in operation at the factory described by Dr. Brown. Dr. Nelson then referred to the question of returned soldiers reentering industry. He said that he was connected with several factories in which the management was keen to have back the men who had gone to the war. These men were looked upon as the backbone of the industry. In conclusion, Dr. Nelson said that he appreciated the honour of being asked to address the meeting, and he looked upon the task as a professional duty, because at present there was nothing more important on the medical horizon than the rehabilitation of industrial medicine itself.

Dr. Brown, from the chair, said that those present were indebted to Dr. Nelson. Dr. Brown hoped that the Branch Council, when it considered the programme for 1944, would put on the subject again for discussion, and that the 200 or 300 medical practitioners interested in it would be able to be present. Dr. Brown, on behalf of the Branch members, thanked Dr. Nelson and those who had taken part in the discussion.

### Obituary.

JOHN RAMSAY.

We are indebted to Dr. C. Craig for the following appreciation of the late Sir John Ramsay.

The death of Sir John Ramsay closes a long era in the history of the Launceston General Hospital and a long era also in the history of surgery in Australia. Ramsay first came to the Launceston General Hospital as a house surgeon in 1896. The then surgeon superintendent was Dr. Drake. Drake was the first man to introduce big surgery to Launceston. He is also believed to have been one of the first, if not the first, to use X rays in Australia. He was in England when Röntgen made his discovery in 1895, and he brought back with him an X-ray machine which was installed at the General Hospital, Launceston, in 1896. Ramsay benefited greatly by the teaching of Drake and soon showed an extraordinary aptitude for surgery. When Drake resigned in 1898 Ramsay became surgeon superintendent, although he was then only twenty-six years old. There then began a golden age in the history of the hospital, an age of extraordinary expansion in surgery. The new surgery that followed the discoveries of Lister was at that time just coming into its own. In Australia the development of this surgery was in the hands of a small group of men mostly working in one or other of the big teaching hospitals. Ramsay was practically the only surgeon working in an outside hospital whose work was recognized as being of the same standard as that done in the teaching hospitals. Between 1898 and 1912 everything of note that he did was written down and published. On many occasions he journeyed to the mainland centres to give papers on surgical subjects. A few weeks ago a full bibliography was published in *THE MEDICAL JOURNAL OF AUSTRALIA*. In 1906-1907 he collected funds from the public and built a magnificent theatre which has only just been pulled down. It is very interesting to note, in view of the modern trend of ideas in regard to asepsis, that this theatre had a plant attached to it for purifying and filtering the air that entered it.

He went into private practice in 1912, and although this benefited the public of Tasmania, there is no doubt that it

was a great loss from the scientific point of view, as from that time onwards he published practically nothing. He remained attached to the hospital as honorary consulting surgeon. In 1921 he was appointed as a member of the board of management of the hospital. The year 1933 saw the commencement of another golden age for the hospital when he became chairman of the board of management, which position he retained until his death. Under his management everything in connexion with the hospital bloomed remarkably. Auxiliary societies were formed on all sides. The internal management of the hospital was completely overhauled and renovated. Finally, a completely modern hospital was built. This latter move was, of course, one initiated by the Government, but Ramsay played a great part in its development.



He was a man of extraordinary personality and there was nothing with which he was associated that did not become a success. In any medical assembly he was always an outstanding figure and a centre of interest. In spite of his power of domination he always chose to rule by the methods of consultation rather than by those of dictation, and a great deal of his success was due to his skill in moulding opinion before he finally launched a new project. In the months before he died he had made his great object the building up of a medical reference library in Tasmania, and it is to be hoped that this object will gradually be attained.

He was a big man for the community in every way and his loss will be felt for many years to come.

Dr. J. A. NEWELL writes: By the death of Sir John Ramsay Tasmania has lost one who was an outstanding personality, both as a surgeon and as a citizen.

Graduating when surgery was in its infancy, he was to see the evolution of surgery to its present-day efficiency. He took a creditable part in that evolution in Australia.

He was a man of extraordinary enthusiasm and had a great capacity for work. He spared no effort to keep himself abreast of new departures and advances in surgery, and as far as practicable, putting them to a practical test. His visits to continental and American clinics made him conversant with the methods and technique of the world-renowned surgeons. He insisted on possessing the most modern surgical equipment and had built up a large medical library.

His pioneer work in local anaesthesia, the continuous saline drip, and X-ray diagnosis was a pleasant memory to him in

his later years. Hospital administration and construction were of great interest to him during the whole of his professional life, and the development of the present Launceston General Hospital and its efficiency are in a large degree due to his efforts.

Only three months ago he celebrated the fiftieth anniversary of his graduation, an event which brought to him much pleasure and satisfaction and hearty congratulations from his colleagues. One of Ramsay's characteristics was his insistence on keeping the closest personal touch with his patients. His meticulous care of, and attention to, the post-operative patient always excited admiration, and must have conducted materially to the success of his surgery. This conscientious thoroughness with which he performed his work did not relax even in the minutest detail. His wholehearted and inexhaustible enthusiasm was a constant stimulus to his fellow practitioners, who were never denied the benefit of his experience. A clear and logical thinker with an unbounded confidence in his own judgement, he followed tenaciously the course which he considered to be right. His high ideals of professional ethics and conduct earned for him the respect of his professional brethren. Ramsay was a man of dominating personality, but of a kindly and sympathetic disposition, which won for him a familiar and affectionate popularity. He had a keen sense of humour and enjoyed congenial company.

Outside his professional work his interests were wide and varied. He was a sound business man and an enthusiastic Rotarian. He was the moving spirit in the Saint John Ambulance Association for many years. In his earlier years Ramsay was as thorough and vigorous in sport as in his professional work. He was a good golfer, an exceptional billiardist, and a hard-hitting batsman.

To those of us who knew him so well over the past years, Ramsay's life appears as one of solid achievement. His sterling qualities and genial personality will remain as guarded memories. His wife and family have our sincere sympathy.

DR. W. P. HOLMAN writes: It is difficult enough to find words suitable to describe the loss of a truly great personality to a large community. Still harder is it to set down the intimate and personal way the death of Sir John Ramsay is felt in northern Tasmania.

Sir John was best known as a surgeon and a hospital administrator, as others will record—but it will serve as an indication of his capacity that in 1923 he visited Frankfurt to investigate the early large claims of deep X-ray therapy and rightly at the time decided against installing the equipment in his hospital. His critical interest in radiotherapy was not discouraged, and it was with some pride, as chairman of the Launceston General Hospital, that in 1937 he watched over the organization of its first-class radiotherapy department.

When the writer became his assistant in 1925 he found a modern thirty-bed private hospital which Sir John had built, fully equipped for diagnostic radiology, standard clinical biochemistry and bacteriology, with a microtome for section cutting, and let it be said—a lift!

In the operating theatre this courageous and enterprising surgeon introduced techniques he had learned from Moynihan, Crile and the Mayos, whose autographed books stood on his shelves as an endorsement of his professional standing.

His patients soon came to know that when things were going badly, a couch would be provided not far from the ward and John Ramsay would quite literally be there to carry the fight on with all his powers. His reputation is perhaps highest with his own nursing staff of those years.

It is rather unlikely that any busy surgeon kept a larger or more used library and few worthwhile advances escaped his early notice.

Outside his profession he was a giant in the community. In business his counsel was sought and respected. The list of companies he helped to direct is not required here. Yet he found time for other activities, and when any social organization of value was started his name was usually recorded as first president. Rotary will serve as a good example.

Finally, he was a sociable man and liked nothing better than good company. How many will remember his laugh! His knowledge of men, his wide reading and his cool judgement could easily be detected, but these are not unique. Yet in this community he was unique. The indefinable extra qualities of John Ramsay cannot be summed up. Now we have lost him we begin to know them.

## Post-Graduate Work.

### WEEK-END COURSE AT ARMIDALE.

THE New South Wales Post-Graduate Committee in Medicine announces that, in conjunction with the Northern District Medical Association, it will hold a week-end course at Armidale on Saturday, April 22, and Sunday, April 23, 1944. The programme is as follows:

#### Saturday, April 22.

##### At the Literary Institute, Armidale.

- 2 p.m.—"Non-Tuberculous Diseases of the Lungs": Major G. C. Moss.
- 3 p.m.—"Painful Feet": Dr. J. W. Hoets.
- 4.30 p.m.—"The Rh Factor in Obstetrics": Dr. H. B. Williams.
- 5.15 p.m.—"Neurological Hints": Major G. C. Moss.
- 8 p.m.—"Ante-Partum Hæmorrhage": Dr. H. B. Williams.

#### Sunday, April 23.

##### At the Literary Institute, Armidale.

- 9.30 a.m.—"Cardiac Disorders": Major G. C. Moss.
- 10.15 a.m.—"Bone Infections": Dr. J. W. Hoets.
- 11.30 a.m.—"The Use of Drugs in Obstetric Practice": Dr. H. B. Williams.
- 2 p.m.—Inspection at the Hinton Art Collection at Armidale Teachers' College.

The fee for the course will be £1 1s., except for members of the defence forces, who will be admitted free of charge. Those intending to be present are requested to notify Dr. R. J. Jackson, Honorary Secretary, Northern District Medical Association, Armidale, as soon as possible.

## Correspondence.

### OTITIS EXTERNA DIFFUSA: A PERSONAL EXPERIENCE.

SIR: It is always interesting for a medical man to experience in person some of the maladies for which he is constantly prescribing in others. I am only referring to minor ills and not those requiring, in the words of Oliver Wendell Holmes, that the "visitor become the visatee". In these, of course, we willingly hand ourselves over bodily to our colleague, follow unquestioningly his instructions and refuse to read his prescriptions on the principle that if we were not equal to treating ourselves we should at least not arrogate to ourselves the role of consultant. For minor ills, I might give as an example the "common cold", which the layman, not thinking medical assistance necessary, treats by a course of profanity, libations of rum engendering an aggressive irritability towards all who have the temerity to approach him.

Very different is the position of the medical man who with the whole pharmacopœia at his disposal sets out with relish to combat the infection. Having learnt from experience the necessity of early treatment, he starts off with a diaphoretic in the form of *Spiritus Ætheris Nitrosi*, and, borrowing from the homeopath, adds a minim of tincture of aconite. To be rewarded soon after by a relief from internal congestion—a pleasant feeling in the skin engendered by the slight diaphoresis and the satisfaction of soon knowing that his kidneys are busy eliminating toxic matter. At the right time and regardless of the expense of the half-finished bottle, he switches over to *Vinum Ipecacuanhæ*, and at once receives the benefit of its expectorant attributes and the satisfaction of knowing that in addition he is receiving a gastro-intestinal stimulant and cholagogue. He may also at this stage help the expectorant action of the first by adding a little *Vinum Antimonialis*, and at the same time benefit by its sedative effect on circulatory and nervous systems and its antispasmodic effect if he has spasms. At the appropriate time he will know that a stimulant expectorant in the form of squills is indicated, the tincture or *Ozymel Scillæ*, bearing in mind the incompatibles of the latter. He also has the comfort of knowing that his heart is receiving the benefit of a cardiac tonic. Soon the toughness and scantiness of the phlegm will inform him that ammonium carbonate is indicated and in addition obtain

relief from any digestive disturbance by its antacid properties. Finally, having reached the stage of the persistent irritable cough—known as a brassy cough—he knows that some opium derivative is indicated which by transmutation restores the silver quality of his voice and he is himself once more.

After these prolegomena I will proceed with the subject of this letter which I proved did not lend itself to self-treatment, for it is a strange fact that although the whole surface of the body is accessible to the hand except for a small area in the interscapular region, full 90% of the ills afflicting a medical man are out of range of both touch and sight.

Two articles appeared in your issue of November 27 by Dr. Davis and Dr. Earnshaw dealing with this ear trouble and the treatment of the established condition was both adequate and effective. I had been subject to such attacks recurring at intervals, and my ear was packed with gauze impregnated with ichthyol and glycerine, and I used to have a very uncomfortable week of it. I had been recommended to use 2% mercurochrome and derived no appreciable benefit once the auditory canal was inflamed. When a slight pain started in my ear I used to dread the inevitable week of pain and discomfort I knew was in front of me.

On one occasion when slight pain in the auditory meatus started I soaked a small pledget of wool on the end of a match in this 2% mercurochrome, inserted it into the meatus and pushed against the walls to allow some of the solution to run to the bottom of the meatus. To my surprise the attack was aborted and the treatment proved effective in preventing further attacks. I always carry the solution when travelling and have now no fears of diffuse external otitis becoming established, the remedy being applied in the way indicated at onset of slight pain or discomfort.

I think, therefore, that if this solution were given by the medical officers to any man complaining of pain in the external auditory meatus, the majority of the cases seen in the early stage would be aborted and thus save the patient from an attack and the medical officers the time and trouble of cleaning up the meatus.

Undated.

Yours, etc.,

A. CAMPBELL.

## Naval, Military and Air Force.

### CASUALTIES.

ACCORDING to the casualty list received on March 17, 1944, Major J. R. Cornish, A.A.M.C., of Grassmere, South Australia, who was previously placed on the "seriously ill" list, is now reported to have been removed from all lists.

## Australian Medical Board Proceedings.

### NEW SOUTH WALES.

THE undermentioned has been registered, pursuant to the *Medical Practitioners Act, 1938-1939*, of New South Wales, as a duly qualified practitioner:

Robertson, Athol Herbert, M.B., B.S., 1938 (Univ. Melbourne), H.M.A.S. Kuttabul, c/o G.P.O., Sydney.

## Books Received.

"Surgery of Modern Warfare", edited by Hamilton Bailey, F.R.C.S.; Sub-Editor for Medicine: C. Allan Birch, M.D., M.R.C.P., D.C.H., D.P.H., M.M.S.A.; 1944. Third Edition. (To be published in six parts.) Edinburgh: E. and S. Livingstone. Part I, compiled by seventy-six contributors, 8 $\frac{1}{2}$ " x 6", pp. 171, with 165 illustrations, many in colour. Part II, compiled by seventy-seven contributors, 8 $\frac{1}{2}$ " x 6", pp. 153-328, with 146 illustrations, many in colour. Price: 15s. net each.

"Pathology and Therapy of Rheumatic Fever", by Leopold Lichtwitz, M.D., with a foreword by William J. Maloney, M.D., LL.D., F.R.S. (Edinburgh), edited by Major William Chester, M.C.; 1944. New York: Grune and Stratton, Incorporated. 9" x 6", pp. 226, with illustrations. Price: \$4.75.

"Fractures and Joint Injuries", by R. Watson-Jones, B.Sc., M.Ch.Orth., F.R.C.S. Volume II. Third Edition: 1943. Edinburgh: E. and S. Livingstone. 9 $\frac{1}{2}$ " x 6 $\frac{1}{2}$ ", pp. 411-960, with many illustrations. Price: 75s. net per set. Postage 1s.

"The 1943 Year Book of Urology", by Oswald S. Lowale, M.D., F.A.C.S.; 1943. Chicago: The Year Book Publishers. 7" x 4 $\frac{1}{2}$ ", pp. 416, with illustrations. Price: \$3.00.

"The 1943 Year Book of Industrial and Orthopedic Surgery", edited by Charles F. Painter, M.D.; 1943. Chicago: The Year Book Publishers, Incorporated. 7" x 4", pp. 440, with many illustrations. Price: \$3.00, post paid.

"Clinical Biochemistry", by Ivan Maxwell, M.D., B.S., M.Sc., B.Agr.Sc., F.A.C.I., F.R.A.C.P.; Fifth Edition; 1944. Melbourne: W. Ramsay (Surgical) Proprietary Limited. 8 $\frac{1}{2}$ " x 5 $\frac{1}{2}$ ", pp. 394, with illustrations, three pages of which are in colour. Price: 27s. 6d.

## Diary for the Month.

- MAR. 30.—New South Wales Branch, B.M.A.: Annual Meeting.  
MAR. 31.—Queensland Branch, B.M.A.: Branch Meeting.  
APR. 4.—New South Wales Branch, B.M.A.: Council Meeting.  
APR. 5.—Victorian Branch, B.M.A.: Branch Meeting.  
APR. 5.—Western Australian Branch, B.M.A.: Council Meeting.  
APR. 11.—New South Wales Branch, B.M.A.: Executive and Finance Committee.  
APR. 11.—New South Wales Branch, B.M.A.: Organization and Science Committee.  
APR. 11.—Tasmanian Branch, B.M.A.: Branch Meeting.  
APR. 14.—Queensland Branch, B.M.A.: Council Meeting.  
APR. 14.—Victorian Branch, B.M.A.: Ethics Subcommittee.  
APR. 17.—Victorian Branch, B.M.A.: Hospital Subcommittee.  
APR. 17.—Victorian Branch, B.M.A.: Finance Subcommittee.

## Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

**New South Wales Branch** (Honorary Secretary, 135, Macquarie Street, Sydney): Australian Natives' Association; Ashfield and District United Friendly Societies' Dispensary; Balmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phoenix Mutual Provident Society.

**Victorian Branch** (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

**Queensland Branch** (Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL, or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

**South Australian Branch** (Honorary Secretary, 178, North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

**Western Australian Branch** (Honorary Secretary, 205, Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia.

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